

Aerial Surveys for Waterbirds and Seabirds in the South West of England and Wales: 2007 Final Report

WWT Consulting
Report to
Department for Business, Enterprise
and Regulatory Reform

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1. INTRODUCTION

- 1.1** Data on the numbers and distribution of waterbirds and seabirds in UK inshore waters are required for a variety of purposes, including strategic environmental assessment for the second round of offshore windfarm (OWF) development, the Environmental Impact Assessments required by Round 2 wind farms, compliance with licence conditions for constructed Round 1 windfarms, for monitoring of waterbird numbers and distribution in inshore waters, and identification of Special Protection Areas (SPAs).
- 1.2** Prior to 2004, only limited data on the abundance or distribution of waterbirds was available for many nearshore waters in England and Wales (*eg* Cranswick *et al* 2003, Wetlands Advisory Service 2003, Cranswick *et al* 2004). Consequently, the then Department of Trade and Industry (now the Department for Business, Enterprise and Regulatory Reform (DBERR)), supported by other Government departments, agencies and industry, commissioned large-scale survey of strategic areas identified for the second round of OWF development, plus adjoining areas identified as potentially important for birds.
- 1.3** The first comprehensive survey was undertaken by WWT Consulting in 2004/05 (Department of Trade and Industry 2006), with a subsequent programme of surveys from winter 2005/06 through to summer 2006 (DBERR in press). These provided large-scale survey data covering the nearshore waters of strategic windfarm areas in Northwest England (from Anglesey to the Solway Firth), in the Greater Wash and in the Thames (from Flamborough Head, Yorkshire, to Sandwich Bay, Kent). DBERR commissioned a third programme of aerial surveys to be undertaken between January and March 2007, which included repeat surveys of many of the previously surveyed areas and included new areas in the south west of England and Wales (referred to here as the South West Strategic Area).
- 1.4** This report provides results from aerial survey in the South West Strategic Area during the third programme of aerial surveys, undertaken between January and March 2007. This report augments the report for surveys undertaken during the same programme in the North West, Greater Wash and Thames Strategic Areas. The numbers of birds encountered are provided, and estimates of total numbers calculated using ‘distance analysis’ are presented for the more numerous species of conservation importance. Maps are provided showing the large-scale distribution of waterbirds in the South West Strategic Area.

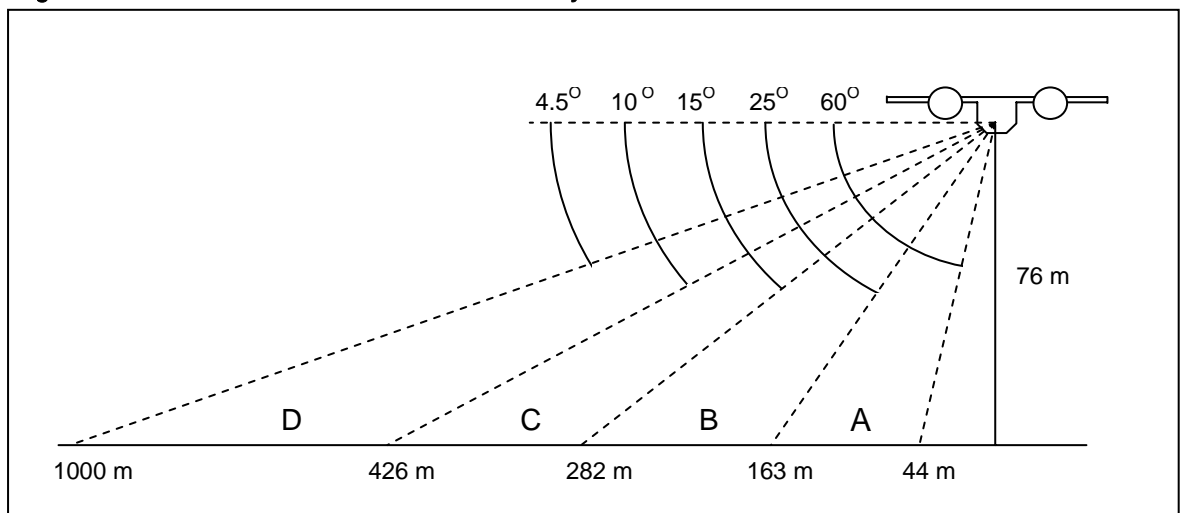
2. METHODS

Aerial survey

- 2.1** Aerial surveys used for this report were undertaken using a methodology developed in Denmark by the National Environment Research Institute (NERI) (Kahlert *et al* 2000; see also Camphuysen *et al* 2004). This involved a ‘distance sampling’ approach (see Buckland *et al* 2001), whereby the distance to each bird/flock of birds was recorded. Because birds further from the observer will be more difficult to detect, recording of distance allows the number of missed birds to be estimated. This approach allows statistical analyses of the data (*eg* confidence limits to be calculated for estimates of numbers) that are not possible with data collected using previous aerial survey methods. Furthermore, using a combination of the time at which birds were encountered and the track flown by the plane (recorded using a Global Positioning System (GPS)), the locations of observed birds can be calculated with considerable accuracy (in most cases, to within a few hundred metres).

- 2.2** Aerial surveys were undertaken by WWT Consulting using experienced observers who have undertaken aerial surveys previously for many of the OWF sites and to identify sites for potential classification as SPAs in the UK between 2001/02 and 2005/06.
- 2.3** A number of Partenavia PN68 aircraft were used, flying at an altitude of 76 m and a speed of approximately 200 kmh⁻¹. The location of the plane was recorded every five seconds using a GPS, with a second, backup GPS, recording location every eight seconds.
- 2.4** A series of north-south transects spaced 2 km apart was designed to cover nearshore waters. Transects that run north-south reduce the effect of glare during the survey, thus aiding the detection and identification of birds. The transects are assigned to flying blocks, which represent the optimal length of survey (approximately 600 km). For the 2007 programme, any transects used in previous large-scale or regional surveys were retained to enable comparison of data with previous results. Consequently, transects in areas covered for the first time in 2007 were created by extension of those already in use. In the South West Strategic Area, one survey block on the south coast of Wales, SW3, had been partly surveyed previously, so this was incorporated in the new block design. For ease of planning the north-south transects followed northings of the GB Ordnance Survey grid.
- 2.5** For each bird or flock of birds, the species, number, behaviour, distance band and the time at which it was perpendicular to the flight path of the plane were recorded using a dictaphone. Using a clinometer, birds were located in one of four distance bands covering an area from 44 m to 1,000 m either the side of the plane (Figure i); birds beyond 1,000 m from the flight path of the plane were not recorded. The survey method assumes that all birds in distance Band A were detected, and effort was concentrated on this band. Inevitably, birds further from the plane in other bands are missed owing to their distance from their plane and the need for the observers to concentrate observation on the area of sea nearest the flight line.

Figure i – Distance bands used for aerial survey (not to scale)



- 2.6** Surveys were generally made during a four-hour Period centred on midday GMT to minimise the effects of glare on counts. Surveys were undertaken in good weather conditions, generally with wind speeds of 15 knots or less.
- 2.7** Survey was suspended during the turns between transects, though significant observations, *eg* notable bird species, cetaceans or large flocks of birds, were sometimes recorded on an *ad hoc* basis.
- 2.8** A cautionary approach was taken with regard to species identification, such that only those individuals that were observed clearly were identified to species level; otherwise, birds were

identified as belonging to a species group. In the case of large, near mono-specific flocks, such as scoter (*Melanitta* spp. comprised almost entirely of Common Scoter *M. nigra*), individual, similar, but less common species may not have been identified, particularly in the further distance bands. However, experience has shown that the inclusion of these does not significantly alter the overall numbers of the more commonly recorded species, though may lead to under-recording of the less common species.

- 2.9** Following this, ducks not identified to species were recorded as ‘duck spp.’ whilst divers (*Gavia* spp.) not identified to species level were recorded as ‘diver spp.’.
- 2.10** Gulls not identified to species level were identified as being in one of the following species groups: ‘grey gull’ (Common Gull *Larus canus* or Herring Gull *Larus argentatus*), ‘black-backed gull’ (Lesser black-backed Gull *Larus fuscus* or Great black-backed Gull *Larus marinus*), ‘large gull’ (Herring Gull, Lesser black-backed Gull or Great black-backed Gull), ‘small gull’ (Black-headed Gull *Larus ridibundus*, Common Gull, Little Gull *Larus minutus* or Kittiwake *Rissa tridactyla*) or gull (*Larus* spp. or Kittiwake).
- 2.11** Auks are not readily identified to species level during aerial survey and most observations are recorded as ‘auk spp’. The majority of auks encountered during the survey are believed to have been Guillemots *Uria aalge*, with smaller numbers of Razorbills *Alca torda*. Whilst no puffins *Fratercula arctica* were specifically identified, a proportion of observations were suspected to be of this species.
- 2.12** Cormorants *Phalacrocorax carbo* and Shags *Phalacrocorax aristotelis* can be difficult to distinguish from one another during aerial survey. Any birds not identified to species level were recorded as ‘cormorant spp’.
- 2.13** Other species groups were also used as appropriate, where specific identification of birds to species level was not possible, eg ‘goose spp.’, and ‘wader spp.’.

Survey area

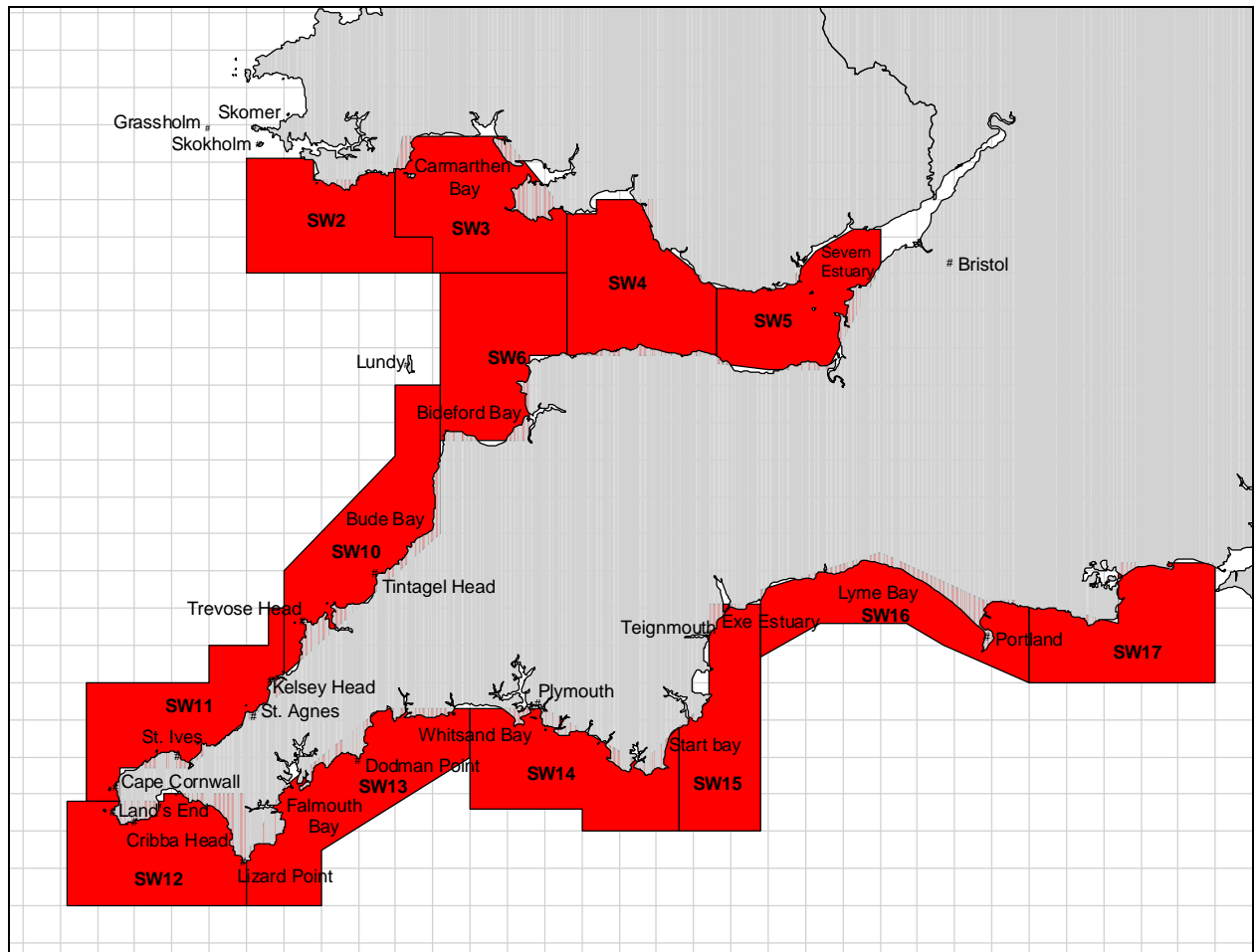
- 2.14** The survey area was divided into a series of survey blocks that could be covered by a single plane in one day. The survey area was designed to cover all Round 2 OWF sites being investigated, plus a buffer zone and any control areas, and to cover areas known or thought to be important for waterbirds and seabirds. The boundaries of the survey blocks were placed to avoid cutting any possible OWF footprints and any areas known to be important for marked concentrations of birds, such as shallow water banks.
- 2.15** Thirteen survey blocks were identified for the South West Strategic Area (Figure ii).

Coverage

- 2.16** The distribution of many waterbirds wintering in the UK changes during the course of the winter; for example, because many breed outside the UK and migrate here at different times of year, and because of changes in food resources or weather. Changes during summer months will relate particularly to breeding and fledging of young. In previous aerial survey projects, seven survey Periods were identified to record changes in abundance and distribution during the course of the year (Table 1). For this project, data were collected in Periods 3 and 4.
- 2.17** The flight dates in each survey block of the South West Strategic Area undertaken in 2007, are given in Table 2. Block SW17 could not be flown during Period 3 nor SW3 during Period 4 as military activity prevented them from being flown during weekdays, and weekends were plagued by bad weather and conditions unsuitable for survey. Part of SW16 could not be flown in Period 3 nor Period 4 because of the restricted area around the stricken cargo ship *Napoli* that was towed to

Lyme Bay on 19 January. Similarly, part of SW14 could not be completed in Period 4 due to military activity in a danger area. Smaller areas in some other survey blocks could not be covered due to the avoidance of other vessels or temporarily active military areas.

Figure ii – Survey Blocks used in the South West Strategic Area



- 2.18** It should be noted that surveys were only carried out in Periods 3 and 4 in 2007; no surveys were made during Periods 1 and 2, in the latter part of 2006.

Analysis and map production

- 2.19** The precise location of each bird or flock of birds was calculated by linking the time (to the nearest second) at which they were recorded to the location of the plane, recorded by the GPS (generally, every five seconds). Interpolation of the GPS data enabled the position of the plane to be located along the flight path at each second. The locations of birds detected were displaced either side of the flight path at a distance roughly in the middle of the distance band in which they were recorded. The location of most observations is consequently considered to be accurate to within 200-300 m.

- 2.20** The distribution of the more numerous species (or species groups) in each Strategic Area is shown using encounter rate, *ie* the numbers of birds counted per unit length of transect flown. Data are summarised by 2x2 km grid squares, corrected for survey effort (distance flown over which observers were actively looking for birds) in each cell. Casual observations of ‘out of transect birds’ (*eg* those recorded while the plane was turning between transects) were omitted from this analysis.
- 2.21** The density scales used in the maps were selected to illustrate the distribution patterns of encounter rates. They are broadly consistent between surveys but small variations will occur owing to the different conditions of visibility during and between surveys, and the different abilities of observers. Densities are not, however, comparable between species due to different detection rates for different species. Note that the range of relative density values may vary markedly between species and reference should be made to the key in each figure to interpret apparent high concentrations of birds appropriately.

Analytical methods for population assessment

- 2.22** The density and population abundance of Common Scoters, all diver species combined and all auk species combined were estimated using Distance 5.0 software (Thomas *et al* 2005). Line transect methods were employed for the diver and auk analyses and strip transect methods for Common Scoter (due to complications arising from the tendency for scoters to move away from the flight path in response to the plane). No significant differences between observers were found and it was thus unnecessary to include observer as a covariate. Data were post-stratified by flock size or survey block to improve precision, and 95% confidence intervals were obtained by bootstrap simulation. Observations were combined for the South West Strategic Area within each of the survey Periods, and abundance estimates are thus presented as regional totals for each survey Period. The vast majority of Common Scoters and Red-throated Divers were present in one survey block, SW3, which was only surveyed in Period 3. Distance analysis was thus applied separately to Common Scoters and Red-throated Divers in this block for Period 3.

3. RESULTS

Overall numbers and distribution

- 3.1** Maps showing the distribution of bird observations of all species in Periods 3 and 4 are presented in Figures 1 and 2 respectively. Relative densities of all birds encountered in each Period are presented in Figures 3 and 4. These show total numbers of birds counted per 2x2 km grid cell (summing the numbers of birds recorded in flocks), corrected for survey effort.
- 3.2** Total numbers of each species encountered during aerial survey of the South West Strategic Area are given in Table 3. Some differences in numbers between the two Periods are exaggerated by the absence of data for SW3 in Period 4, so totals with and without SW3 data are provided.
- 3.3** Numbers recorded in each individual survey block in each Period are given in Tables 4 and 5. Note these are not absolute numbers of birds in the survey areas, which, where possible, need to be calculated using 'Distance', allowing for the numbers of birds which are missed with increasing distance from the transect line.
- 3.4** Overall, large numbers of waterbirds and seabirds were recorded in the South West Strategic Area, with 36,346 and 21,006 individuals counted in Periods 3 and 4 respectively. The higher number of records in Period 3 was primarily due to coverage of SW3, which included 16,102 birds (of which 13,107 were Common Scoters in Carmarthen Bay).
- 3.5** With the exception of Carmarthen Bay, the highest densities of waterbirds in Period 3 were inshore between Trevoze Head and Cambeak and about 10 km off St Agnes Head on the west coast of Cornwall, and south of Land's End and Cribba Head, south of Falmouth Bay and south of Plymouth on the south coast of Cornwall.
- 3.6** The most obvious change in relative densities between Period 3 and Period 4 is in block SW15 which attained much higher relative densities of gulls and auks in an area from around 6 km off Teignmouth to around 16 km off Start Bay. This appeared to correspond to a general decrease in relative densities of these species along the south Cornish coast.
- 3.7** Relative densities of auks had also increased from around 16 km north of Cape Cornwall towards Kelsey Head, and whilst less dense, the higher concentration recorded inshore between Trevoze Head and Cambeak in Period 3 had extended northwards towards Lundy in Period 4. Also of interest are the noticeably higher relative densities of mainly Gannets, but also auks, in the western transects of SW2, south of Skomer, Skokholm and Grassholm in Period 4.

Common Scoter

- 3.8** Total numbers of scoters counted in each survey block during each Period are given in Table 6. Estimates of scoter numbers calculated using 'Distance' for SW3 in Period 3, the only block with a sufficient number of records for analysis, are provided in Table 7. Relative densities found during each Period are shown in Figures 5 and 6.
- 3.9** With the exception of seven counted in SW4, all scoters counted in Period 3 were in SW3, with 13,107 scoters observed. All scoter observed were recorded as Common Scoter.
- 3.10** The areas of highest relative density were in the north west and south east of Carmarthen Bay, within around 6 km of the coast, with lower densities recorded between these.

- 3.11** Numbers of scoters calculated using 'Distance' were estimated at 26,127. The 95% confidence intervals around this estimate are characteristically high due to the aggregated distribution of this species at sea, and their tendency to flush from survey Band A as the plane approaches.
- 3.12** Without data for SW3, the small number of records (12) in Period 4 precludes comparison between the two Periods. No other major coastal aggregations were identified in the South West Strategic Area during the two survey Periods, though small numbers of birds were dispersed widely in the Western Approaches and Bristol Channel.

Divers

- 3.13** Total numbers of divers (Red-throated Diver, Black-throated Diver, Great Northern Diver and those not identified to species) counted in each survey block during Periods 3 and 4 are given in Table 8. Estimates of diver numbers calculated using 'Distance' for the South West Strategic Area are given in Table 9 for each Period. An estimate for Red-throated Diver numbers in SW3 in Period 3 is also given. Relative densities of divers in Periods 3 and 4 are shown in Figures 7 and 8 respectively.
- 3.14** As with Common Scoter, the majority of observations (63) were from SW3 in Period 3, with the remaining records (43) scattered around the coasts of Cornwall, Devon and Dorset, mainly in bays and near estuaries, such as Bideford Bay and Whitsand Bay. The higher relative densities shown in block SW13 are an artefact of the shorter transect lengths surveyed in these coastal 2 km squares.
- 3.15** The majority of records (33 of 63) in SW3 were recorded as Red-throated Diver, with two Great Northern Divers and 28 not identified to species. A single Black-throated Diver was recorded in SW12 and two in SW13, together with a further Great Northern Diver. With the exceptions of a Great Northern Diver recorded in SW10, and a Red-throated Diver in SW15, the remainder of the records in Period 3 were not identified to species.
- 3.16** Similar numbers of divers were recorded in Period 4 (57). The general geographical spread of observations was similar to Period 3, with some associations with estuaries and bays, such as south of the Exe Estuary,
- 3.17** In Period 4 more divers were recorded off the south Devon and Dorset coasts as Black-throated Diver, with two in SW11, two in SW13, three in SW15 and three in SW16. Five divers were recorded as Red-throated in SW6, SW11, SW12 and SW13, whilst the remainder (42) were not identified to species.
- 3.18** The number of divers calculated using 'Distance' was 583 in Period 3 (with 95% confidence intervals 331 to 884) and 369 in Period 4 (with 95% confidence intervals 238 to 594). The number of Red-throated Divers estimated from those identified in SW3 in Period 3 is 185 (with 95% confidence intervals 67 to 326).

Manx Shearwater

- 3.19** No Manx Shearwaters were counted in Period 3.
- 3.20** The numbers of Manx Shearwaters counted in each block in Period 4 are given in Table 5. Relative densities in Period 4 are shown in Figure 9.
- 3.21** In Period 4 a total of 221 shearwaters were recorded, all identified as Manx Shearwaters.

- 3.22** Most records of this species were made in a strip approximately 12 km off the north west coast of Cornwall, with smaller numbers off the north of the Land's End peninsula and off the south coast of Cornwall, particularly out from Dodman Point.

Gannet

- 3.23** Numbers of Gannets recorded in each Survey Block in Periods 3 and 4 are given in Tables 4 and 5, respectively. Relative densities of Gannet for each Period are presented in Figures 10 and 11.
- 3.24** Large numbers of Gannets were observed in Period 3, with a total of 1,362 counted. These were mainly distributed off the north west coast of Cornwall, south of Land's End and south of Plymouth, with lower densities scattered between, and east along the coast to Portland in Dorset. No Gannets were recorded north of Bude Bay in Period 3.
- 3.25** Slightly fewer Gannets were recorded in Period 4, with a total of 1,072.
- 3.26** The most noticeable change in Gannet distribution in Period 4 was the aggregation of birds south of the breeding colony on Grassholm in Pembrokeshire, with 234 records in SW2 alone. There was also a general decrease in numbers around the Cornish coast and another increase to the south west of Lyme Bay.

Cormorant and Shag

- 3.27** Numbers of Cormorant, Shag and those not identified to species in each survey block in Periods 3 and 4 are provided in Tables 4 and 5, respectively. Relative densities for all cormorant species totalled for each Period are presented in Figures 12 and 13.
- 3.28** A total of 295 Cormorants and Shags were counted in Period 3. Of these, 138 were identified as Shag and 25 as Cormorant with the remaining 132 not identified to species..
- 3.29** In Period 3, most records were from Carmarthen Bay and the southern coasts of Cornwall and Devon, seldom more than 5 km from land. Block SW13 held the majority of records, with 104 Shags, five Cormorants and 127 not identified to species.
- 3.30** A total of 172 Cormorants and Shags were recorded in Period 4. Of these, 85 were identified as Shag, 46 as Cormorant and 41 could not be identified to species.
- 3.31** Records showed a similar geographic distribution to Period 3, though with higher numbers around the Land's End peninsula and with some records off the Dorset coast. There were also more records of cormorant species further from shore than in Period 3.

Fulmar

- 3.32** Numbers of Fulmars recorded in each Survey Block during each Period are presented in Tables 4 and 5. Relative densities for this species in each Period are shown in Figures 14 and 15.
- 3.33** A total of 267 Fulmars were observed in Period 3. The data show a largely clumped distribution, with higher densities south of Pembrokeshire, north of St Ives and south of the Land's End peninsula. Smaller numbers were also found at the mouth of the Bristol Channel and from Tintagel Head south along the coast of Cornwall to the coasts of Devon and Dorset.
- 3.34** In Period 4, a total of 275 Fulmars were recorded. These showed a similar geographical range, but with a less clumped distribution. In Period 4 there were lower numbers south of Pembrokeshire,

with a greater aggregation off the north west Devon coast, then greater numbers along the entire north Cornwall coast. The higher densities south of the Land's End peninsula also extended further east to beyond Lizard Point.

Gulls

- 3.35** Large numbers of gulls were recorded during both Survey Periods in the South West Strategic Area.
- 3.36** Total numbers of gulls recorded in each Survey Block for each Period are presented in Tables 4 and 5. Relative densities of gulls (all species combined) are presented for each Period in Figures 16 and 17.
- 3.37** For Period 3 a total of 11,593 gulls were recorded of which 4,747 were identified to species. Of these, the majority (2,822) were Herring Gulls with a smaller number of Kittiwakes (1,379) and much smaller numbers of the other gull species.
- 3.38** In Period 3 gull records were widely distributed around the coasts of South Wales, Cornwall, south Devon and Dorset with higher relative densities in Carmarthen Bay, the outer Severn Estuary, the west Cornwall coast, between the Land's End and Lizard peninsulas and along the south coast of Cornwall. Overall relative densities of gulls showed no marked relationship with distance from shore.
- 3.39** In Period 4, a total of 10,815 gulls were recorded, from which 1,776 were identified to species. Of these, the majority (954) were again Herring Gulls, followed by Kittiwakes (616) with smaller numbers of the other species.
- 3.40** The most noticeable change in distribution in Period 4 was an increase in numbers and relative density of gulls south west of Lyme Bay in SW15 and a decrease in numbers in SW10, SW11, SW12 and SW13.
- 3.41** Differences in numbers and distribution between gull species cannot be assessed based on just two Periods of observation, and the dependency on quality of each observation as to whether it was assigned to a particular species, or a group of species.

Auks

- 3.42** Large numbers of auks were recorded during both Periods in the South West Strategic Area.
- 3.43** Numbers of Guillemots, Razorbills and unidentified auk species for each Period are presented in Tables 4 and 5. Estimates of auk numbers (all species combined) calculated using 'Distance' for the South West Strategic Area are given in Table 11 for each Period. Relative densities of auks (all species combined) for each Period are shown in Figures 18 and 19.
- 3.44** In Period 3, a total of 8,646 auks were recorded, of which 15 were recorded as Guillemot, 15 as Razorbill, and the rest not identified to species. The highest recorded densities were off Trevoze Head to the west of Bude Bay and also south of Plymouth. Slightly less dense distributions were in Carmarthen Bay, the rest of the west and south coasts of Cornwall and along the coast of Devon.
- 3.45** In Period 4 a total of 8,353 auks were recorded, of which 38 were recorded as Guillemot, one as a Razorbill, and the rest not identified to species. In this survey Period, auks showed an increase in number off the north Cornwall and south west Devon coasts and western transects of SW2, with a corresponding slight decrease in numbers along the south coast of Cornwall.

- 3.46** The number of auks calculated using 'Distance' was estimated as 51,806 in Period 3 (with 95% confidence intervals 44,521 to 58,927) and 39,864 in Period 4 (with 95% confidence intervals 34,574 to 45,702).

Other Species

- 3.47** During Period 3 one grebe *Podiceps* spp., was recorded in SW3 and another in SW15. These were not identified to species.
- 3.48** Several other duck species were recorded during aerial survey of the South West Strategic Area. These included five Wigeon *Anas Penelope* (SW10), and eight Red-breasted Mergansers *Mergus serrator* (SW3) in Period 3 and four Wigeon (SW17), seven Teal *Anas crecca* (SW5) and four Eider *Somateria mollissima* (SW5) in Period 4.
- 3.49** Several species of wader were recorded during survey of SW3, Carmarthen Bay. These included 845 Oystercatcher *Haematopus ostralegus* 20 Dunlin *Calidris alpina* and eight Curlew *Numenius arquata*. Waders were not recorded from other survey blocks as transects generally ended before going over sand or mud flats.
- 3.50** Three Great Skua *Stercorarius skua* were recorded in SW12 and one in SW13 during Period 3.

4. DISCUSSION

Overall summary

- 4.1** The aerial surveys conducted during winter in early 2007 and reported here, have provided near-synchronous large-scale coverage of the south west of England and Wales. They have mapped the numbers and distribution of over 20 species of waterfowl and seabirds over approximately 14,000 km² of inshore waters, identifying areas of high density and documenting changes during the first 10 weeks of the year.
- 4.2** In total, 36,301 waterbirds were counted in Period 3 and 21,006 in Period 4.
- 4.3** The main reason for the difference in totals recorded between Periods was the inability to survey SW3 in Period 4. This was due to continued bad weather at weekends, the only time when flying was permitted. Similarly SW17 could not be flown during Period 3 due to continued bad weather effecting a sea state beyond acceptable survey conditions.
- 4.4** Overall, Carmarthen Bay and the Cornish and south Devonshire coasts held the highest densities of waterbirds and seabirds, with lower densities around the Bristol Channel and along the Dorset coast.
- 4.5** The most abundant species were Common Scoter, gulls and auks. Common Scoters were located almost exclusively in Carmarthen Bay, while the latter two groups, sharing similar distributions in both Periods, contributed enormously to produce the overall distribution of records detailed above. Discussion of these, and the less common species is given below.
- 4.6** The changes in distributions of birds between Periods may be caused by a number of environmental and phenological factors which are themselves linked. The former may include weather and sea conditions and the locations of commercial fishing activities, whereas the latter may include tidal state, breeding state and the dispersal of prey species. It should be noted that whilst the data collected by these aerial surveys have provided a near-synchronous 'snapshot' of the distribution of species, it is outside the scope of this project to analyse relationships with these other factors. Such analysis would also include large uncertainties as data were only collected during two survey Periods. Suggested reasons for the observed patterns of distribution discussed here are speculative and untested. It is hoped that as subsequent surveys of the area are undertaken, patterns in species numbers and distribution will become clearer.

Common Scoter

- 4.7** Aerial Survey Block SW3 incorporates the whole of Carmarthen Bay, the UK's first marine Special Protection Area, designated as it regularly holds numbers of Common Scoters exceeding the level of international importance (16,000, Wetlands International 2006).
- 4.8** The estimate of numbers of Common Scoters in Carmarthen Bay obtained from aerial survey of SW3 in Period 3 was 26,127. This greatly exceeds the international level of importance and is the second highest estimate for Carmarthen Bay since winter 2001/02 (Smith *et al* 2007).
- 4.9** The data obtained for the rest of the South West Strategic Area did not identify any other large aggregations of scoters, but did show that small numbers disperse widely in the Western Approaches and Bristol Channel.

Divers

- 4.10** As with Common Scoter, the highest number of divers was in Carmarthen Bay, with lower numbers distributed mainly off bays and estuaries around the Devon, Cornwall and Dorset coasts.

- 4.11** The estimate of birds identified as Red-throated Diver in Block SW3 in Period 3 was 168 (with confidence intervals 67 to 326). The national wintering population size of Red-throated Diver is 4,900 (Birdlife International 2004) with the level for national importance set at 50. These survey results therefore confirm the importance of the Carmarthen SPA for this species.
- 4.12** Positive identification of small numbers of Black-throated Diver also accord with the South Cornwall Coast Important Bird Area (in Block SW13). Similar numbers were also found north of Land's End in SW11 and further east in SW15 and SW16. As this species is difficult to positively identify, it is likely that additional Black-throated Divers were included as 'diver spp.' which would make estimates of this species higher. These blocks may therefore hold numbers of national importance for Black-throated Diver (numerically just seven birds, as defined in Stage 1.1 of the JNCC SPA site selection guidelines, but currently with a minimum threshold of 50 birds set for birds for which the UK holds a lower proportion of the overall bio-geographic wintering population (Birdlife International 2004)).
- 4.13** The change in distribution of diver records between Periods, with more records further offshore in Period 4 may represent birds dispersing prior to returning to breeding areas, or reflect changes in feeding opportunities.

Auks

- 4.14** The number of auks in the South West Strategic Area calculated using 'Distance' was estimated at 51,806 in Period 3 (with 95% confidence intervals 44,521 to 58,927) and 39,864 in Period 4 (with 95% confidence intervals 34,574 to 45,702). Unfortunately, the similarity between auk species makes them difficult to distinguish during aerial surveys, so estimates cannot be calculated for individual species.
- 4.15** The numbers of breeding individuals in the UK and Ireland of Guillemot, Razorbill and Puffin were last estimated at 1.6 million Guillemots, 220,000 Razorbills and 1.2 million Puffins (Mitchell *et al* 2004). Of these, the vast majority of all three species breed in Scotland, with approximately 7,300 Guillemots 2,000 Razorbills and 500 Puffins breeding in Southern England and 36,000 Guillemots 9,700 Razorbills and 10,000 Puffins breeding in southern Wales.
- 4.16** Even taking estimates at the lower 95% confidence level, the numbers of auks calculated from aerial survey of the South West Strategic Area and the distribution of relative densities shows that some areas are very important for auks in the winter, either supporting nearly the entire southern coastal populations, or an equivalent number including birds dispersed from colonies further north. Indeed, ringing recoveries indicate movement of Guillemots, Razorbills and Puffins from northern colonies into the English Channel and further south into the Bay of Biscay over the winter (Wernham *et al* 2002).
- 4.17** The highest recorded densities in Period 3 were off Trevoze Head to the west of Bude Bay and south of Plymouth. In Period 4 numbers increased off the north Cornwall and south west Devon coasts and south of colonies in Pembrokeshire, with a corresponding slight decrease in numbers along the south coast of Cornwall.
- 4.18** These differences may reflect a restriction in range closer to colonies as birds prepare for breeding, but may also reflect changes in feeding opportunities. In Period 4 there was a substantial increase in numbers of auks in SW15, which corresponded with an increase in gull and Gannet numbers and the number of fishing vessels recorded in this block.
- 4.19** As discussed above, it is hoped that the nature of such trends will become clearer with successive surveys of these areas in different Periods. Once further data is collected, future analyses, combining different species may identify areas regularly used by over 20,000 seabirds and thereby exceeding SPA site selection criteria.

Other species

- 4.20** Data from the South West Strategic Area aerial surveys documented the use of, in particular, the north Cornwall coast by Manx Shearwaters on their return to their UK colonies in Period 4.
- 4.21** Similarly, they indicated a change in distribution of Gannets relating to either or both: birds associating nearer to breeding colonies on Grassholm and the Channel Islands, and changes in feeding opportunities (compare with auks and gulls south west of Lyme Bay (SW15) in Period 4).
- 4.22** Distributional changes were also noted between Periods for Cormorant species and Fulmars which again are likely to reflect changes in breeding site attendance or feeding conditions.
- 4.23** The aerial surveys identified high numbers of gulls. Their distribution included areas of lower density, predominantly of Kittiwakes, and areas of high density associated with commercial fishing vessels, with large flocks of predominantly Herring Gulls, Black-headed Gulls and Kittiwakes. The high relative densities of gulls in SW15 in Period 4 corresponded with an increase in fishing vessels recorded during survey in this block.

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Figures

Observations of birds in the South West Strategic Area are presented in Figures 1 and 2 for Periods 3 and 4 respectively. A single record of birds (whether an individual or flock) is treated as one observation. The approximate boundary of the individual Survey Blocks is shown in green. The grid is the 10 km national OS grid. Note a higher proportion of birds is detected close to the plane, hence the apparent distribution is of lines of birds running north-south along the path of the transects. Also note that SW17 was not covered in Period 3 and SW3 was not covered in Period 4.

Relative densities of all bird observations in the South West Strategic Area are presented in Figures 3 and 4 for Period 3 and Period 4 respectively. Numbers of all species are summed by 2x2 km grid squares, corrected for survey effort.

Figures 5-19 show relative densities for selected species and groups of species, again summed by 2x2 km grid squares and corrected for survey effort.

Figure 1 - Observations of birds in the South West Strategic Area during aerial surveys in Period 3, 2007.

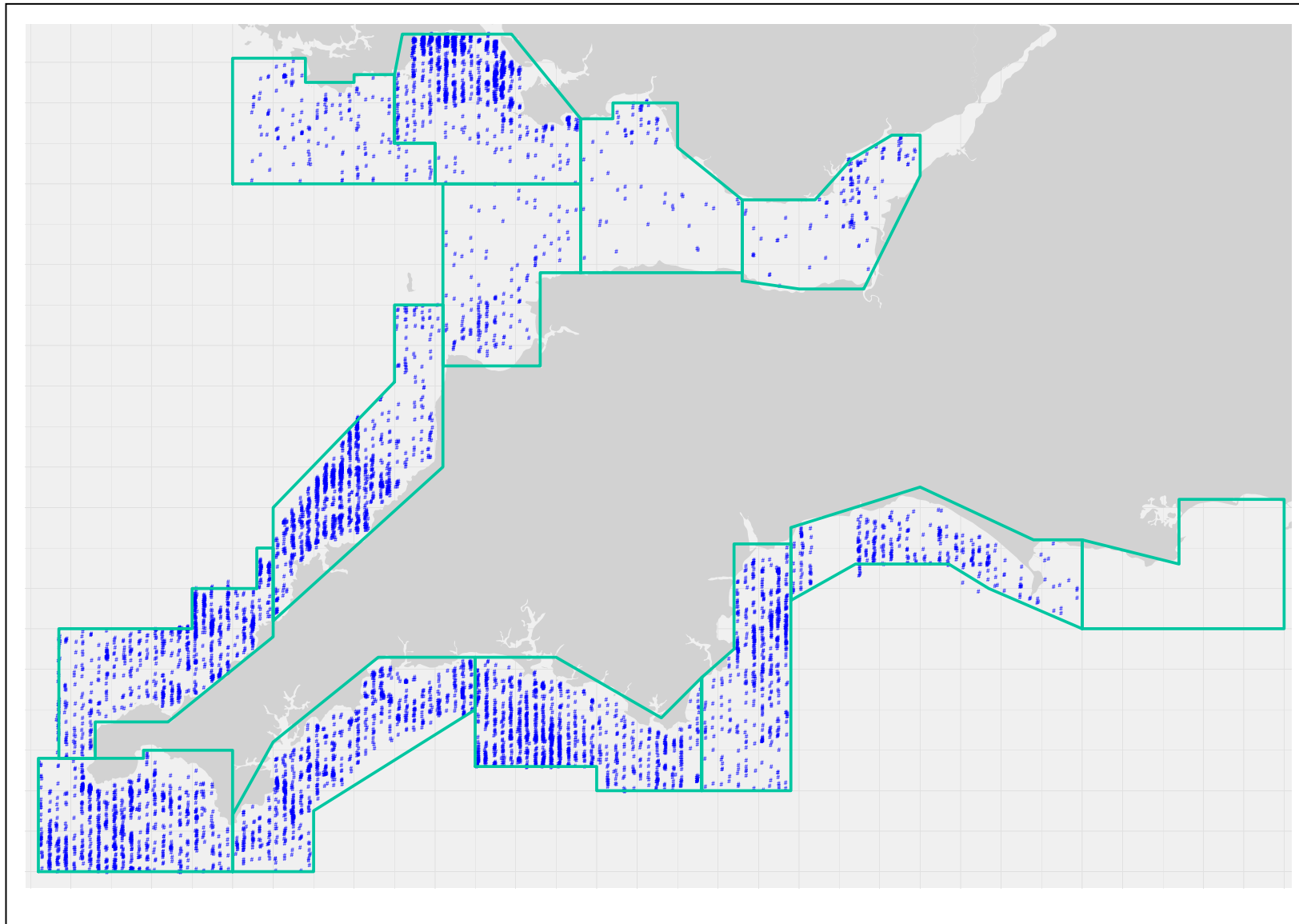


Figure 2 - Observations of birds in the South West Strategic Area during aerial surveys in Period 4, 2007.

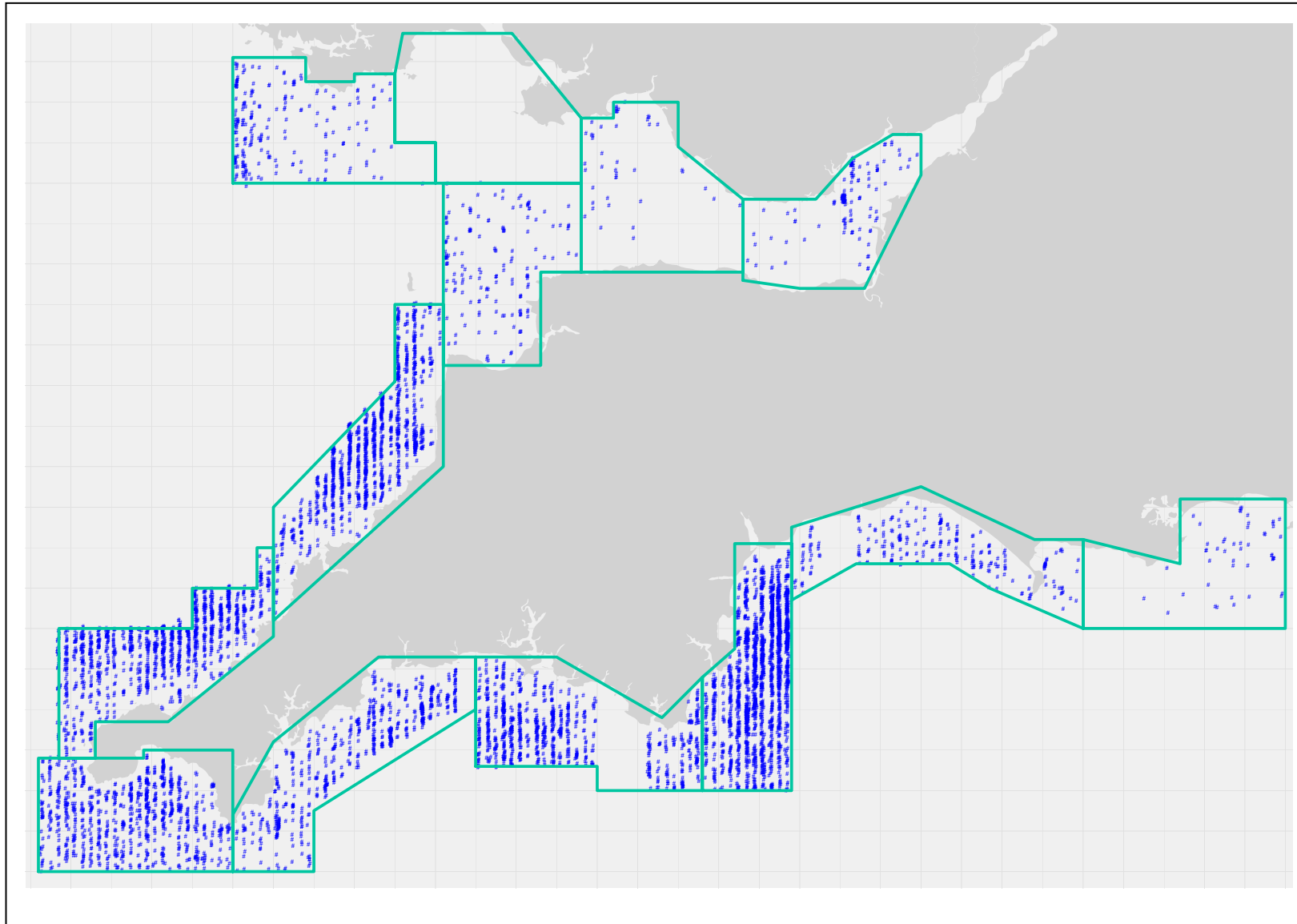


Figure 3 - Relative density of birds recorded in the South West Strategic Area during aerial surveys in Period 3, 2007.

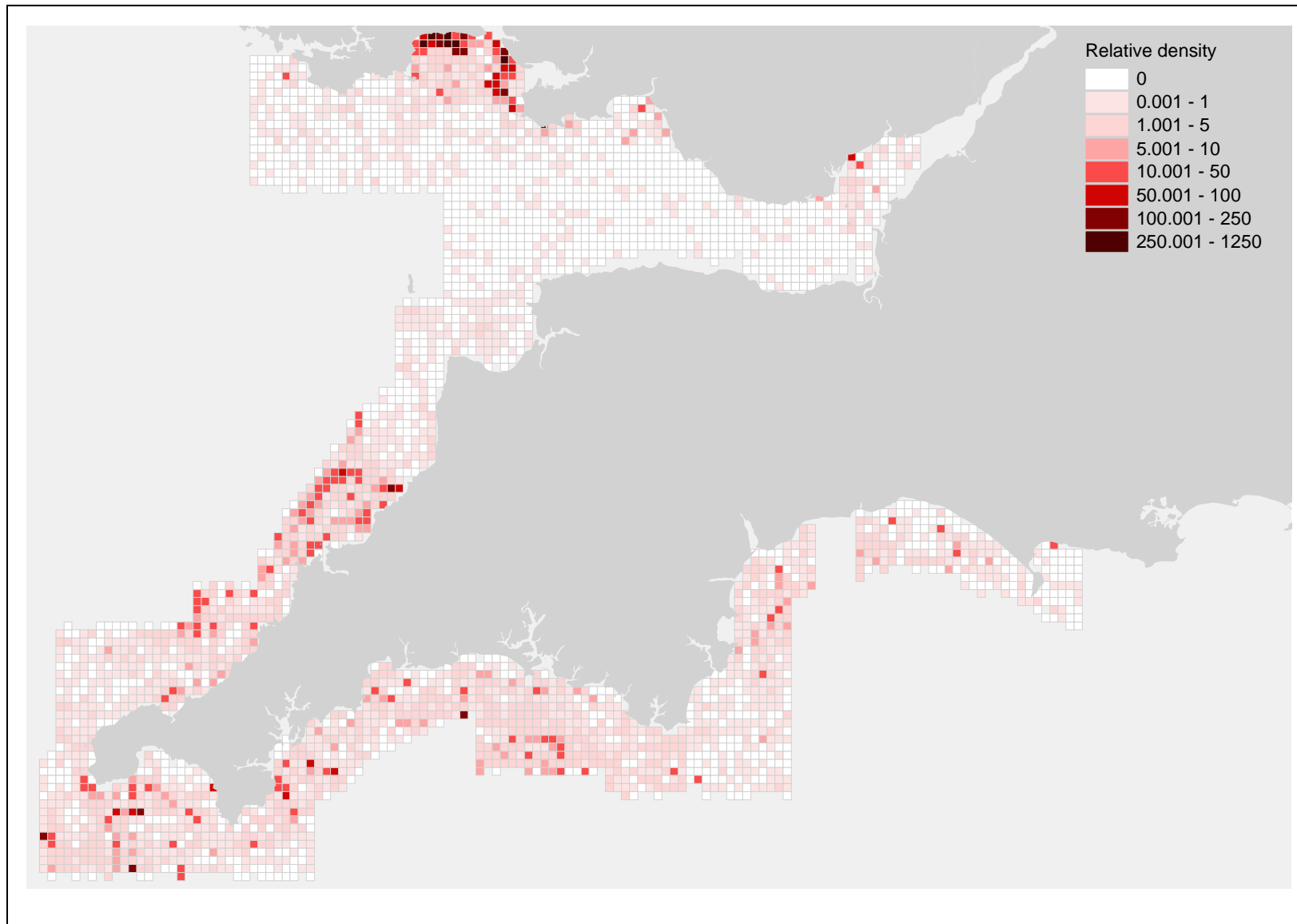


Figure 4 - Relative density of birds recorded in the South West Strategic Area during aerial surveys in Period 4.

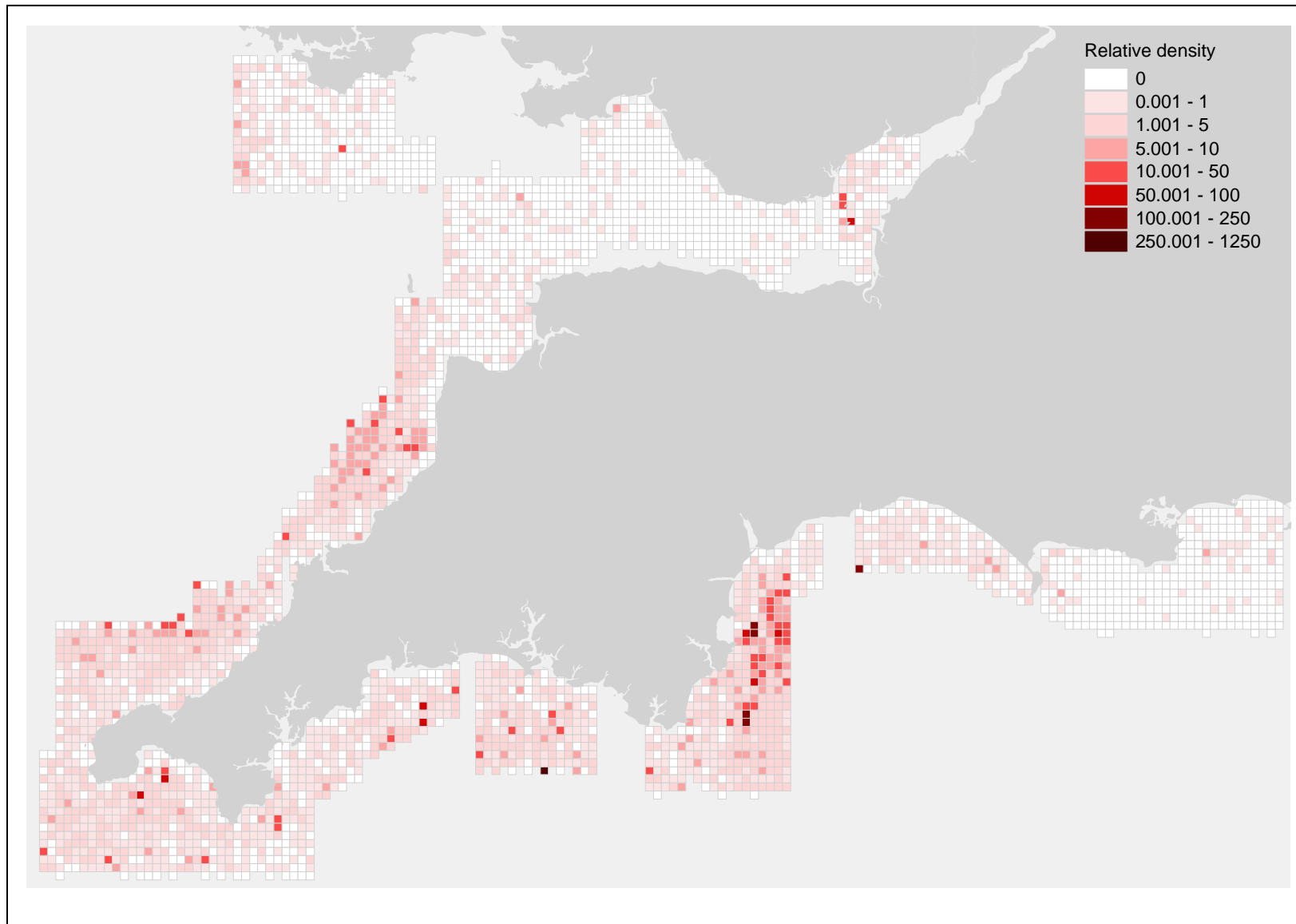


Figure 5 - Relative density of Common Scoters *Melanitta nigra* recorded in the South West Strategic Area during aerial surveys, Period 3.

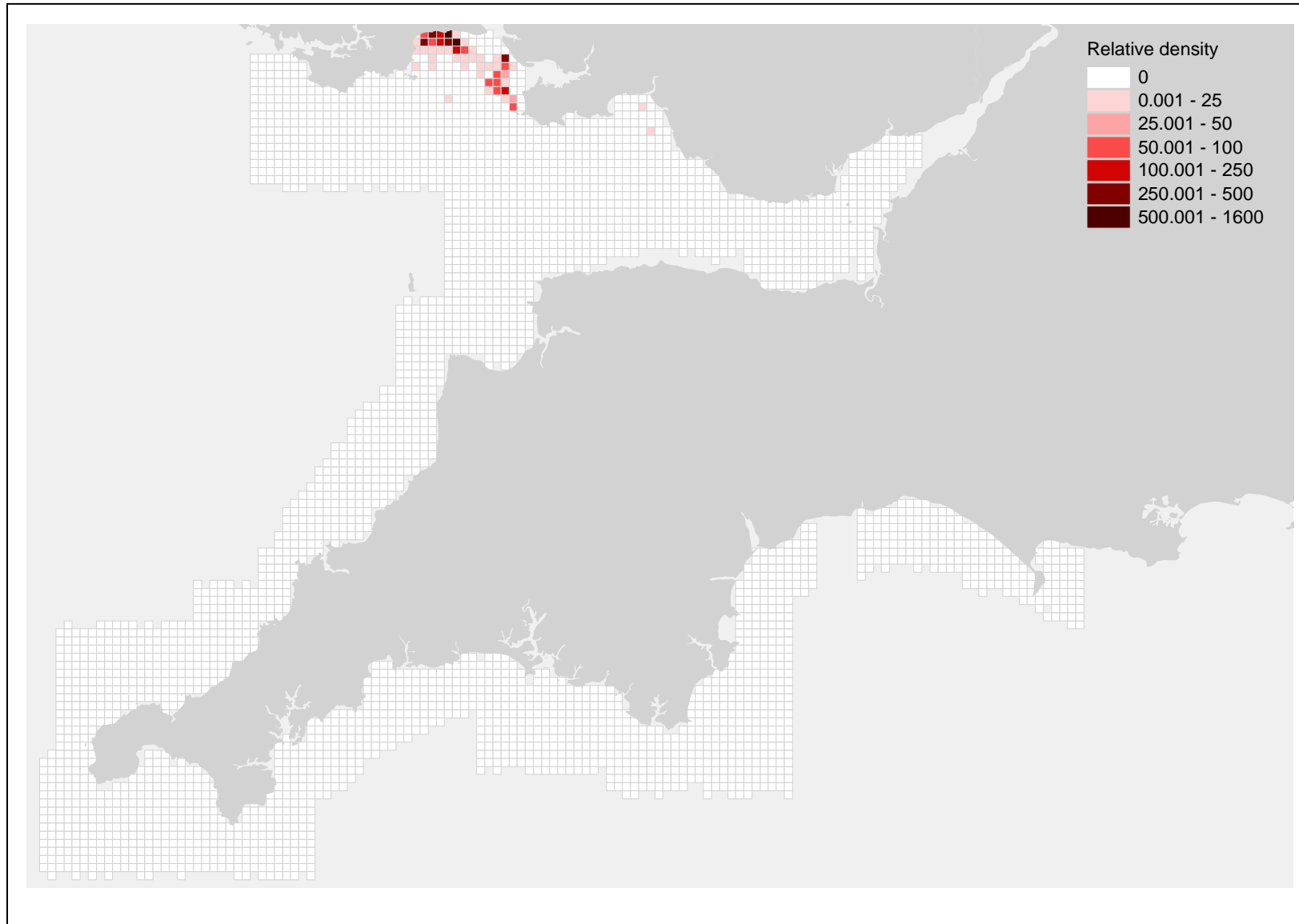


Figure 6 - Relative density of Common Scoters *Melanitta nigra* recorded in the South West Strategic Area during aerial surveys, Period 4.



Figure 7 - Relative density of divers *Gavia* spp. recorded in the South West Strategic Area during aerial surveys, Period 3.

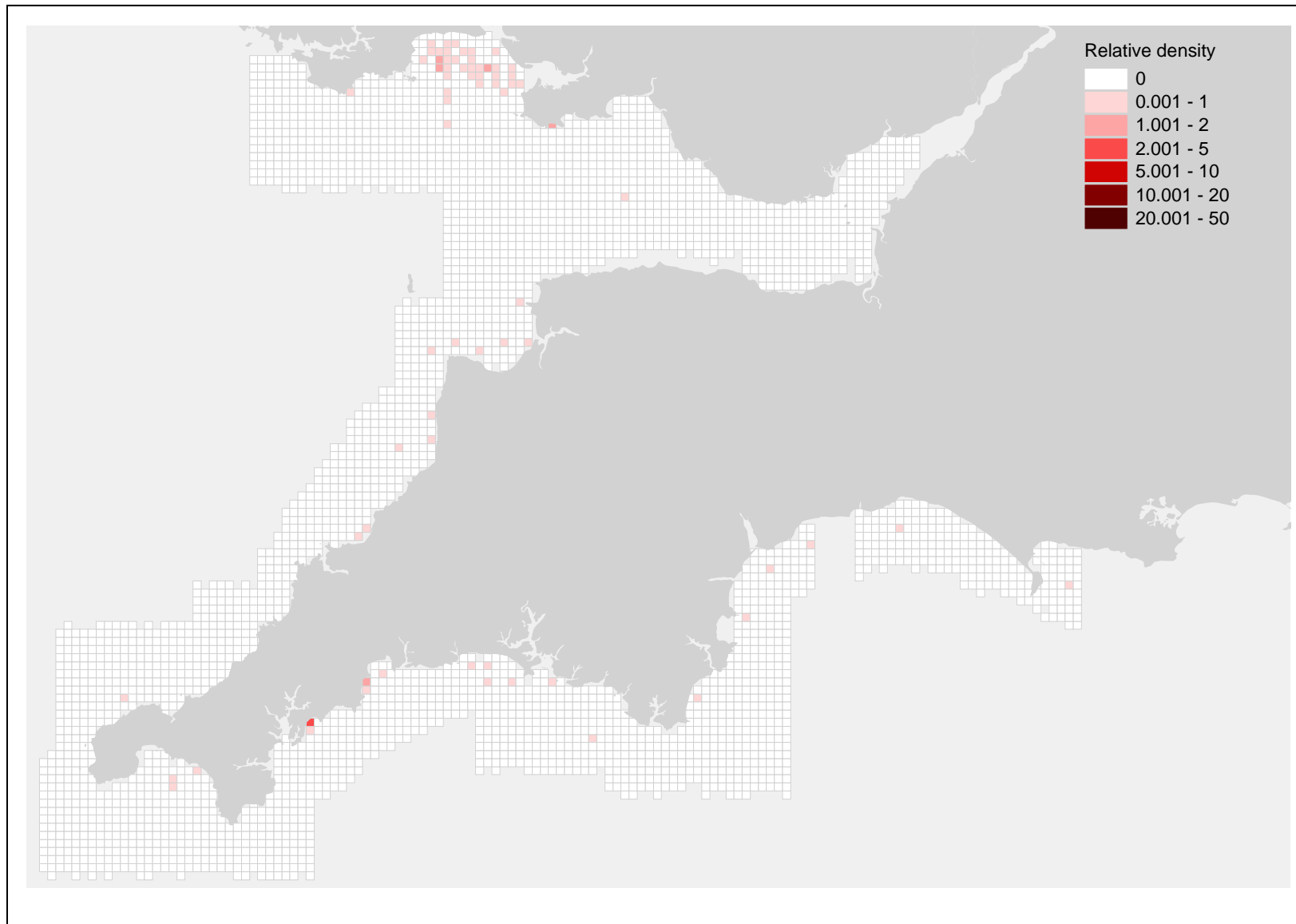


Figure 8 - Relative density of divers *Gavia* spp. recorded in the South West Strategic Area during aerial surveys, Period 4.

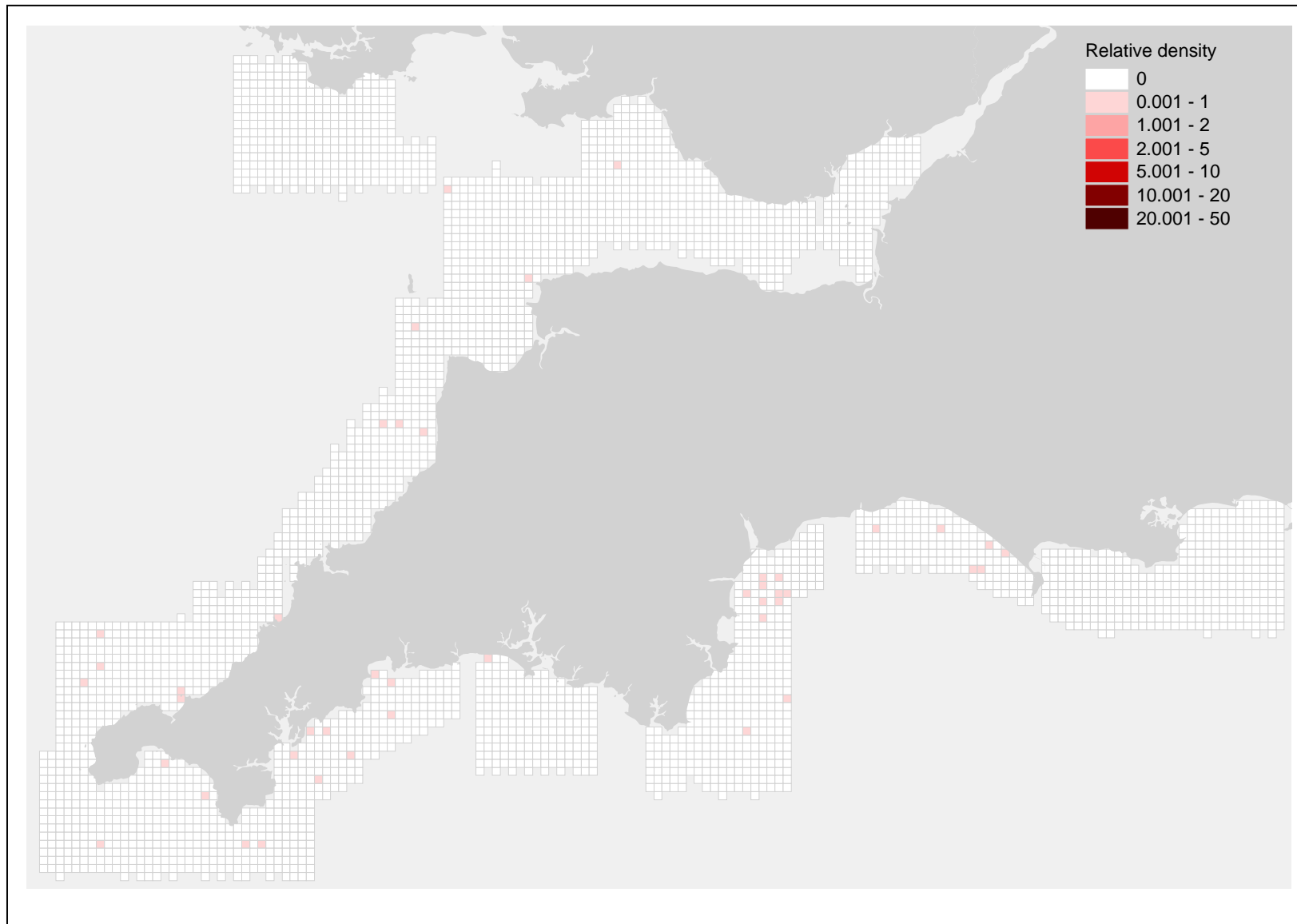


Figure 9 - Relative density of Manx Shearwaters *Puffinus puffinus* recorded in the South West Strategic Area during aerial surveys, Period 4.

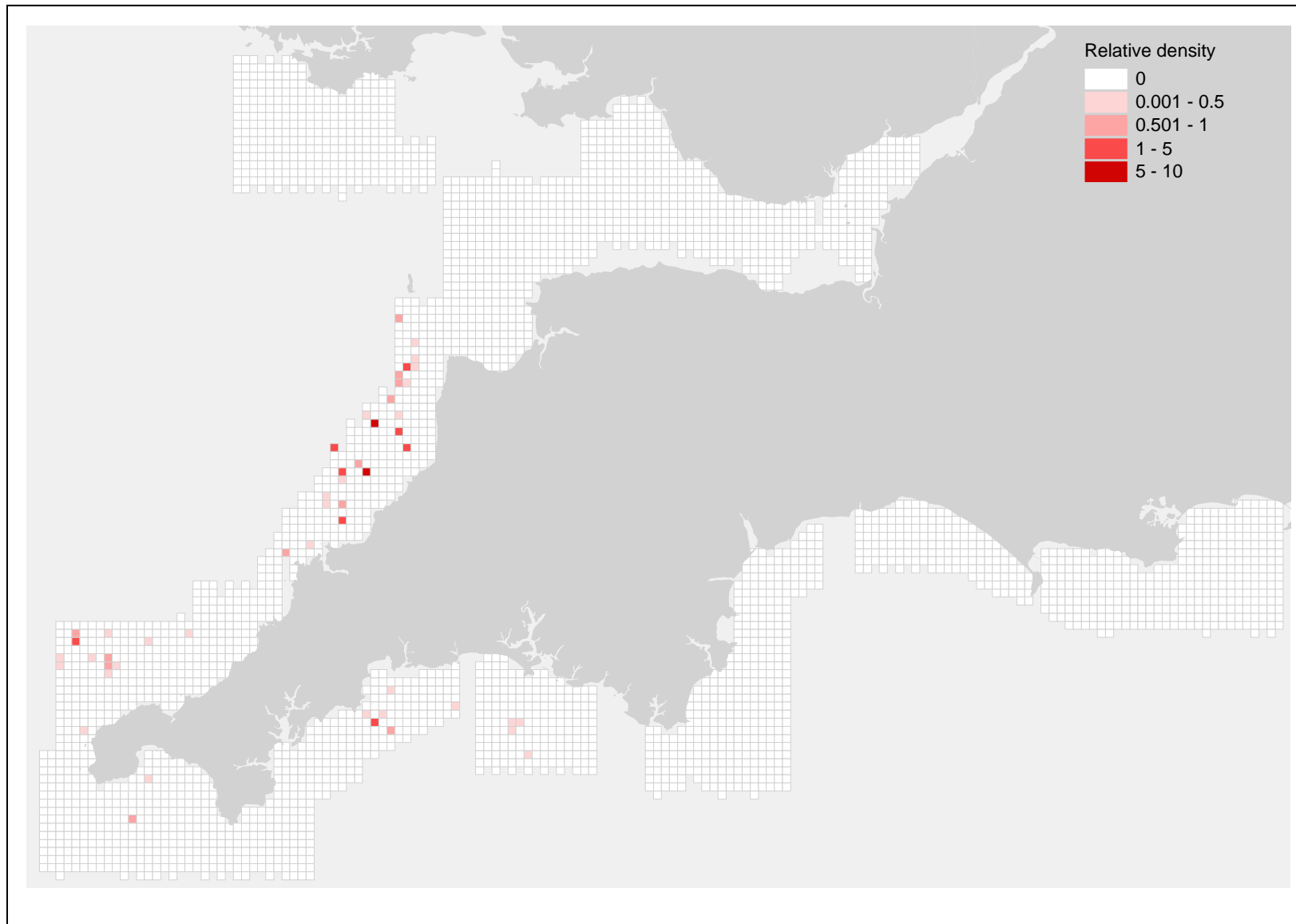


Figure 10 - Relative density of Gannets *Morus bassanus* recorded in the South West Strategic Area during aerial surveys, Period 3.

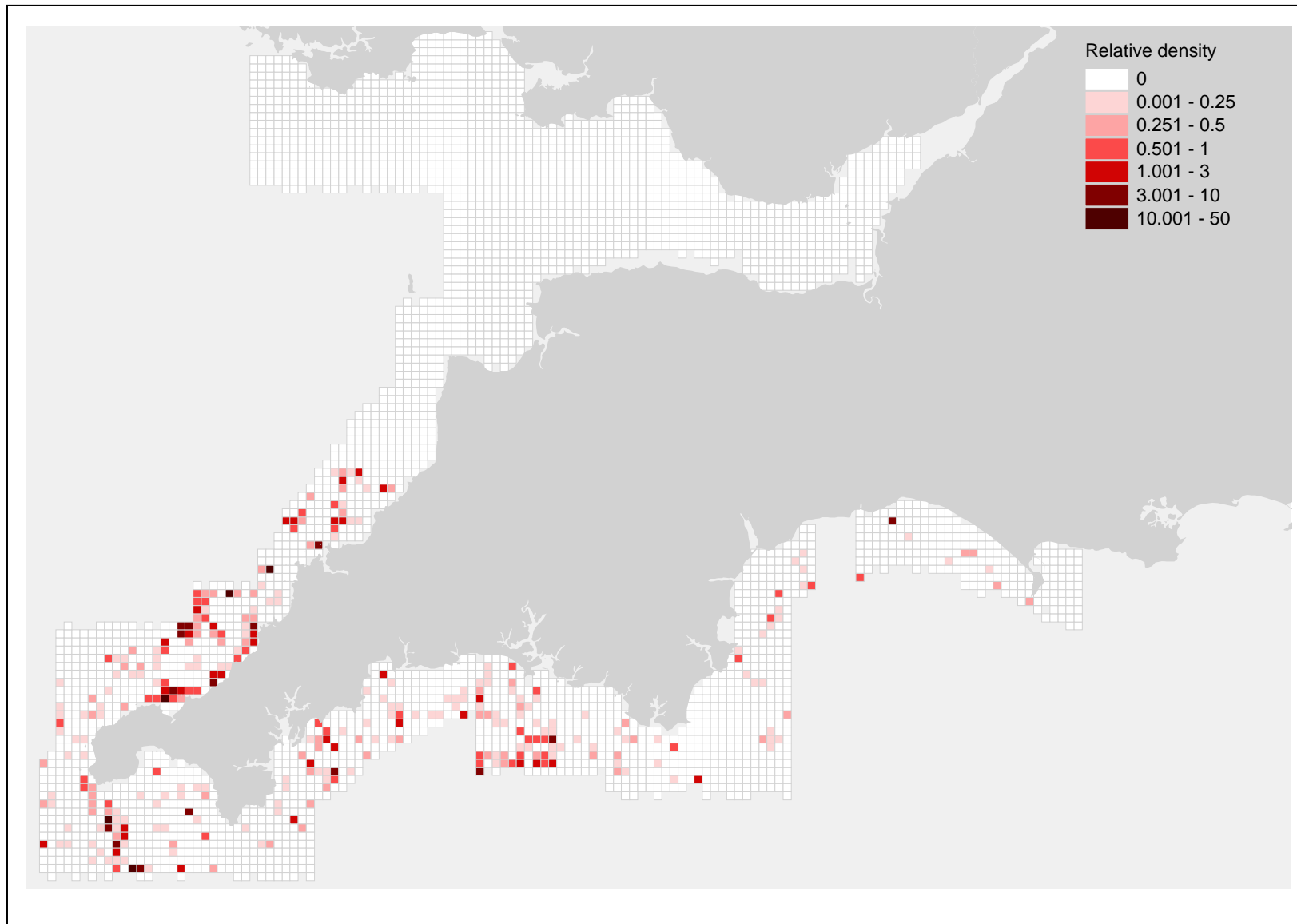


Figure 11 - Relative density of Gannets *Morus bassanus* recorded in the South West Strategic Area during aerial surveys, Period 4.

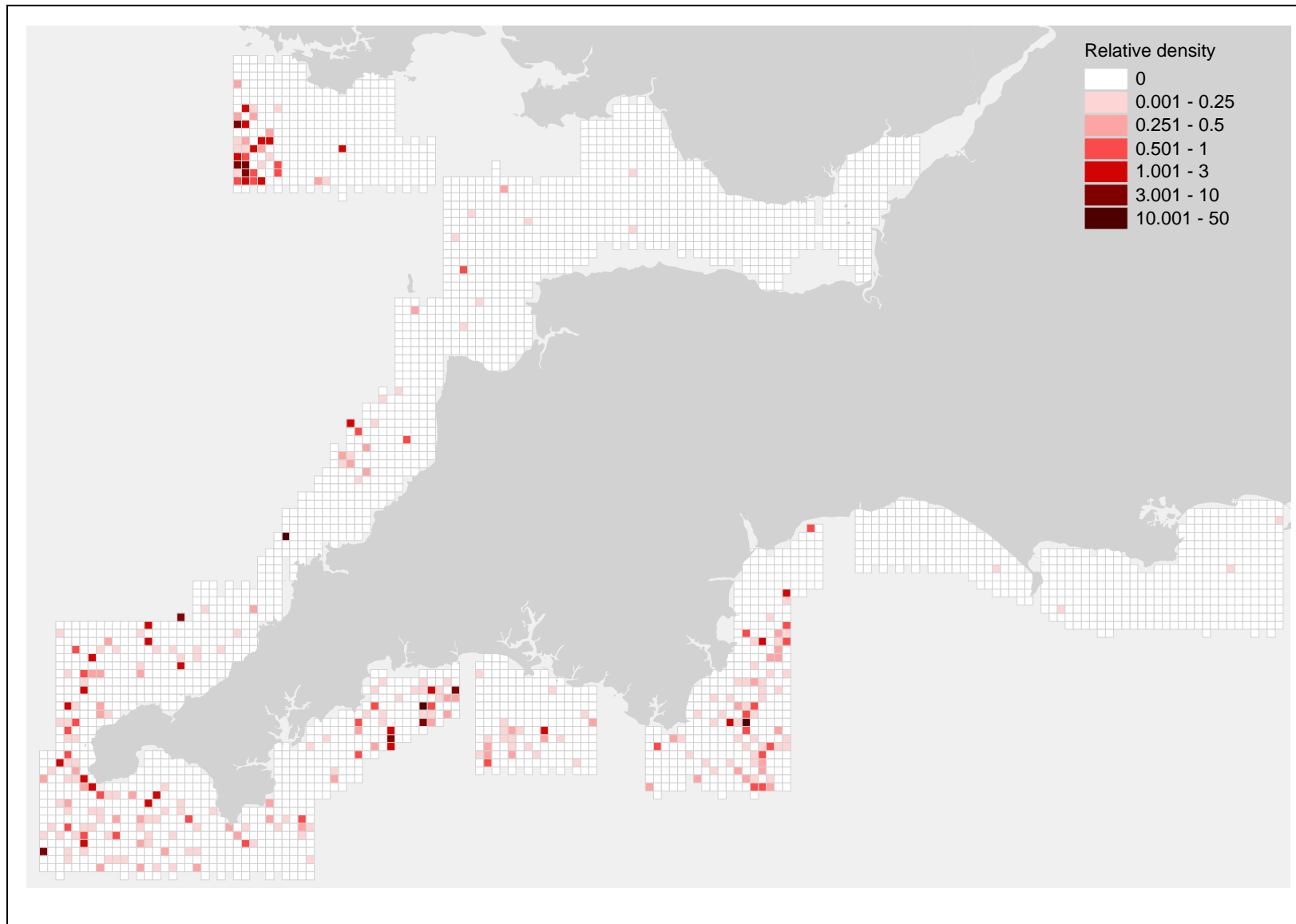


Figure 12 - Relative density of cormorant species *Phalacrocorax*spp. recorded in the South West Strategic Area during aerial surveys, Period 3.

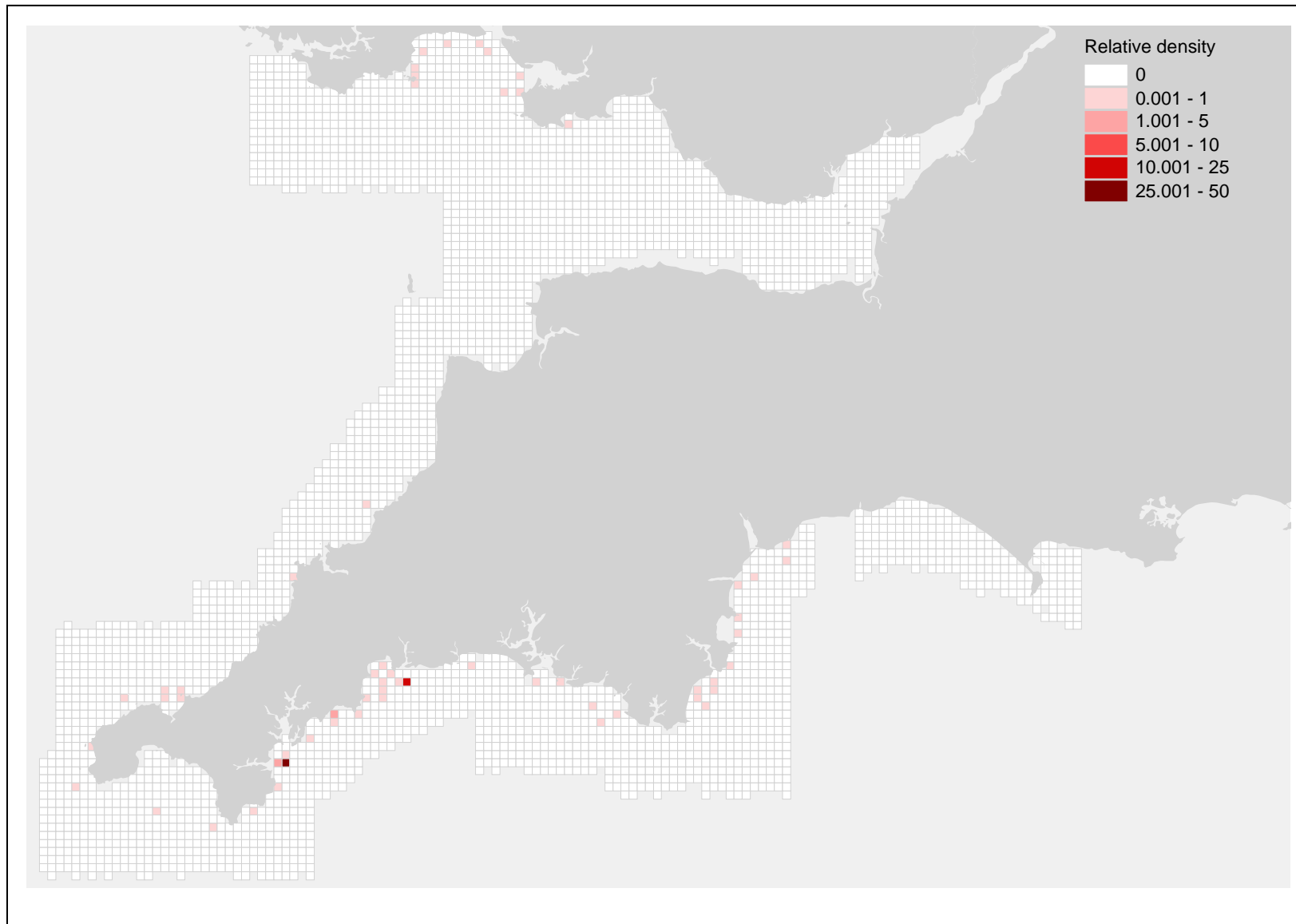


Figure 13 - Relative density of cormorant species *Phalacrocorax* spp. recorded in the South West Strategic Area during aerial surveys, Period 4.

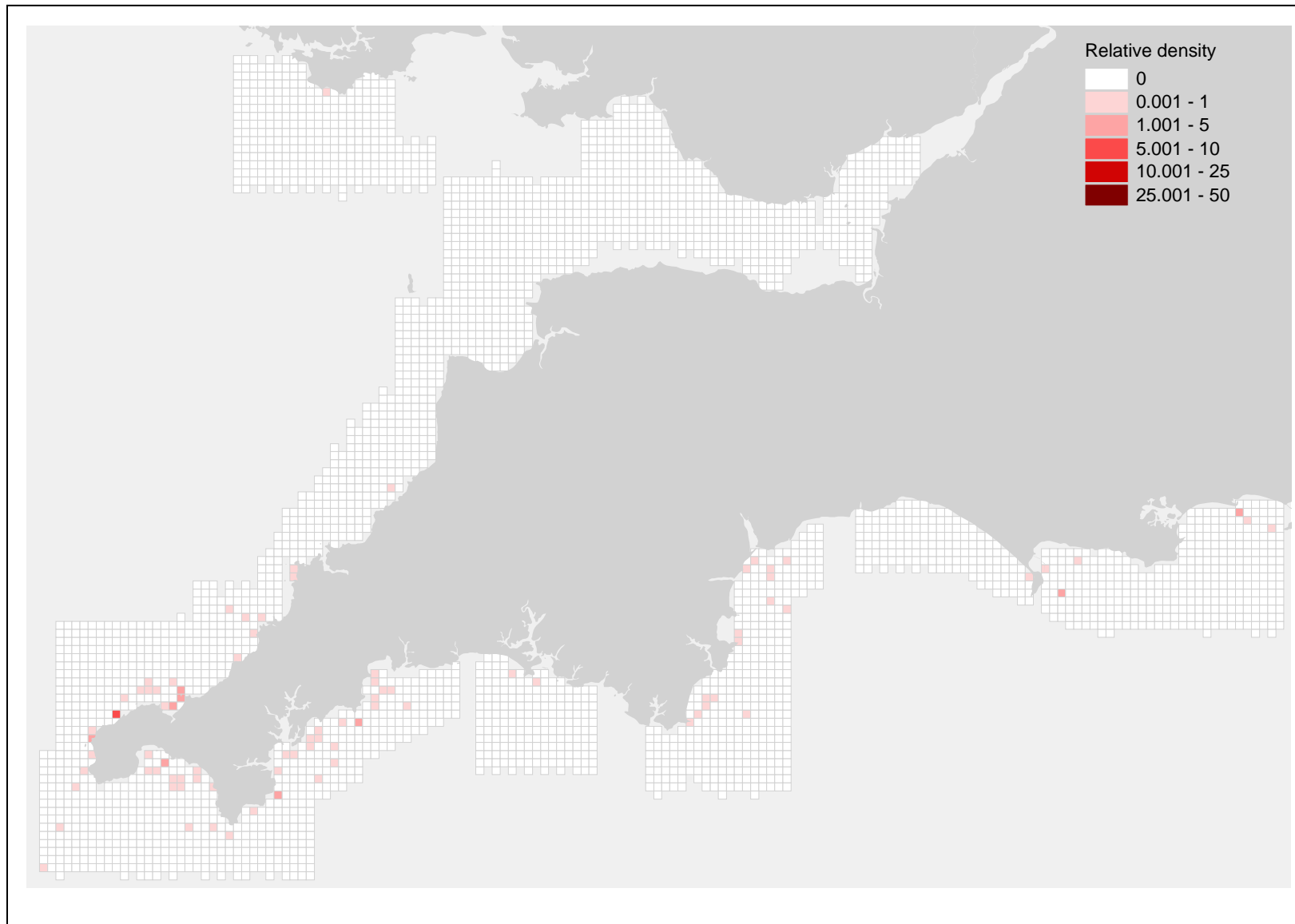


Figure 14 - Relative density of Fulmars *Fulmarus glacialis*. recorded in the South West Strategic Area during aerial surveys, Period 3.

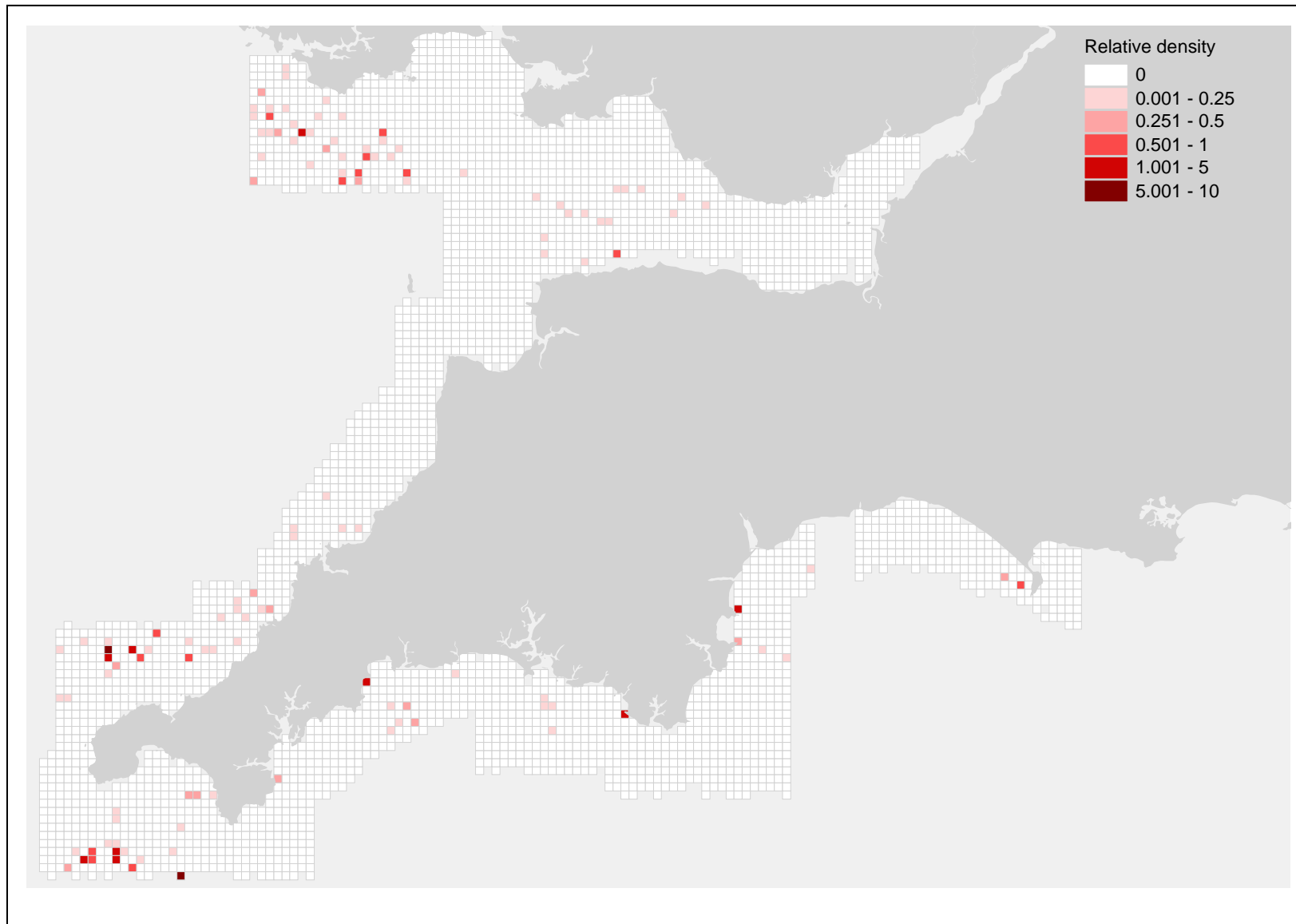


Figure 15 - Relative density of Fulmars *Fulmarus glacialis*. recorded in the South West Strategic Area during aerial surveys, Period 4

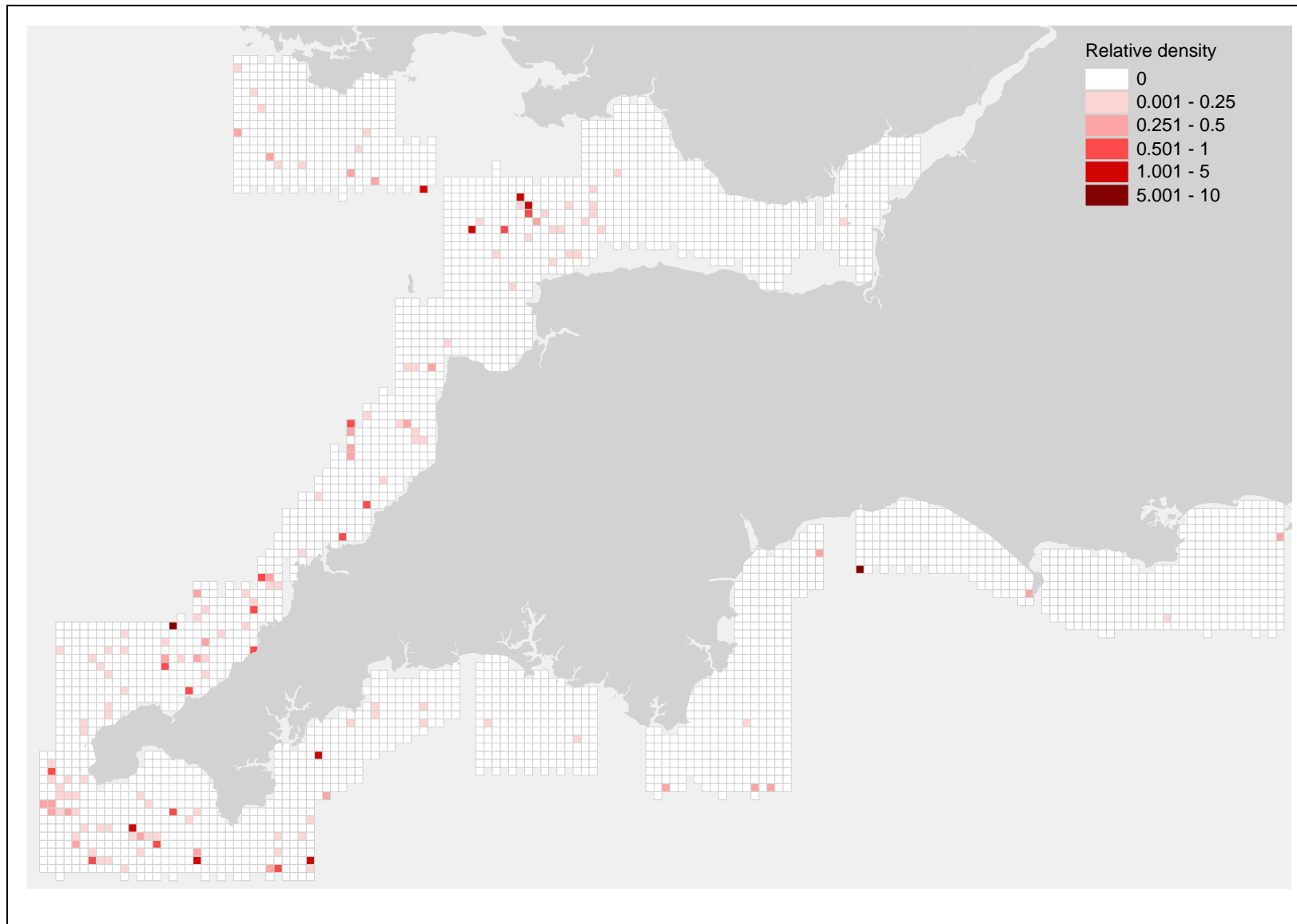


Figure 16 - Relative density of gulls *Larus* spp. recorded in the South West Strategic Area during aerial surveys, Period 3.

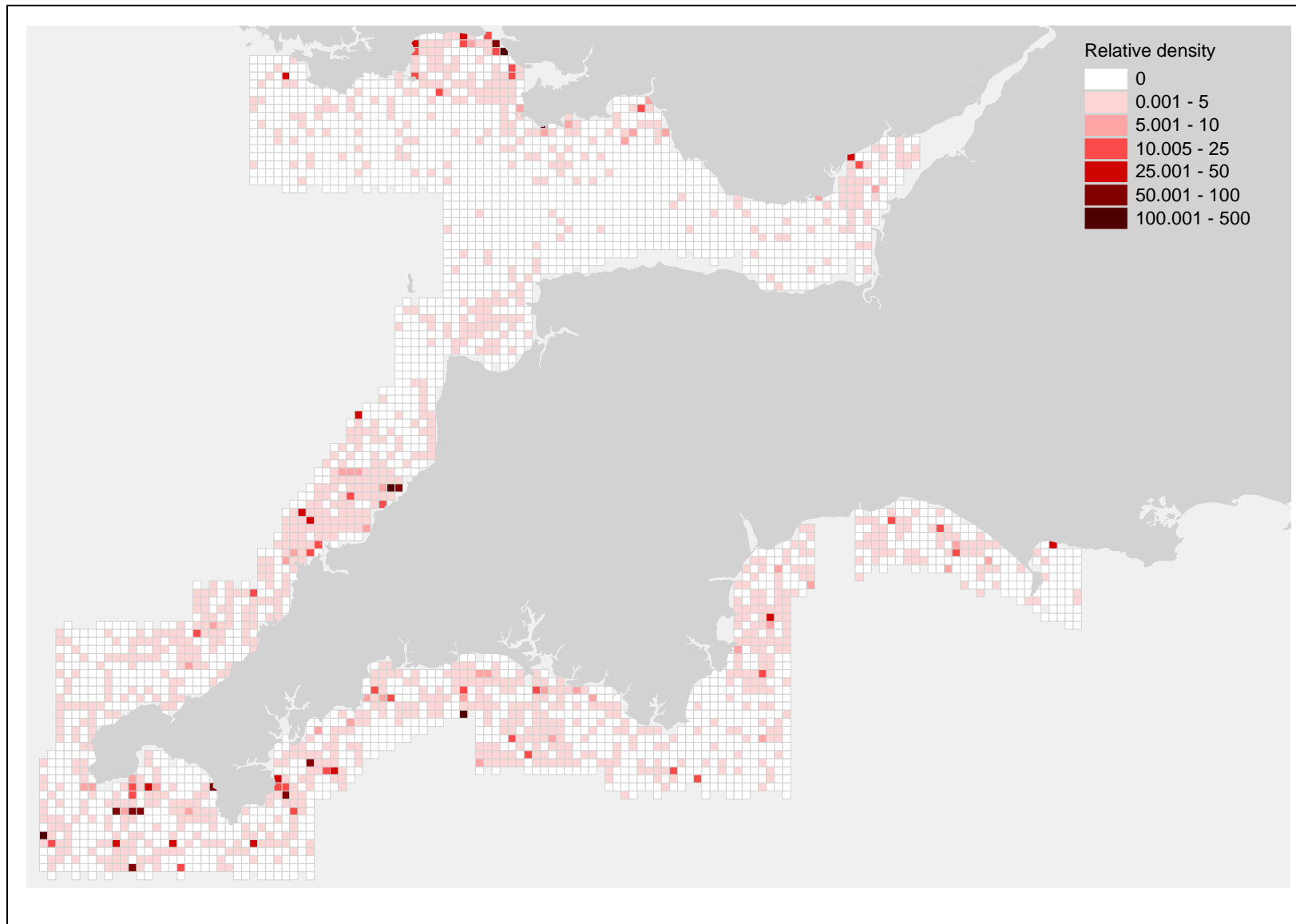


Figure 17 - Relative density of gulls *Larus* spp. recorded in the South West Strategic Area during aerial surveys, Period 4.

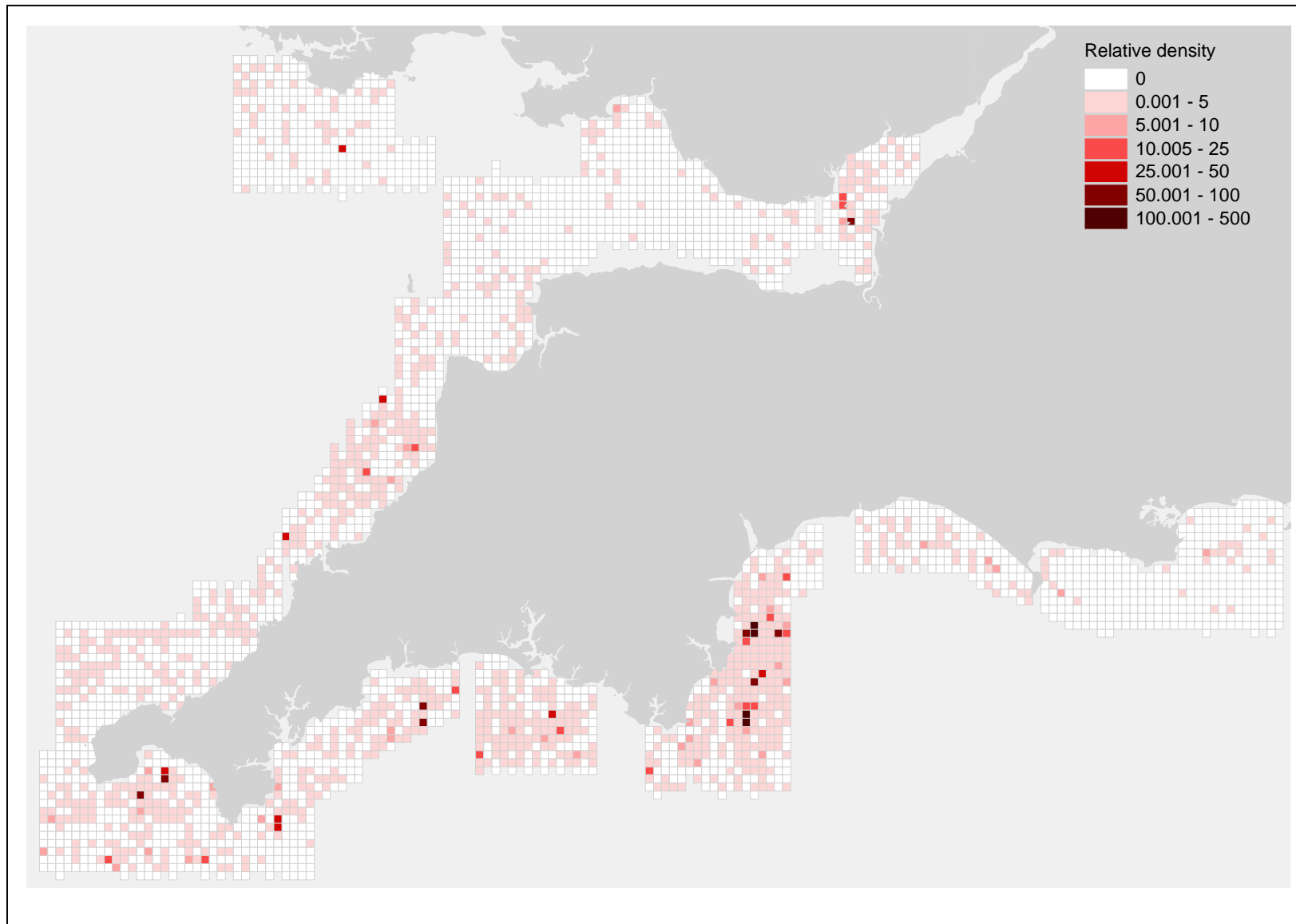


Figure 18 - Relative density of auks *Uria/Alca/Fratercula* spp. recorded in the South West Strategic Area during aerial surveys, Period 3.

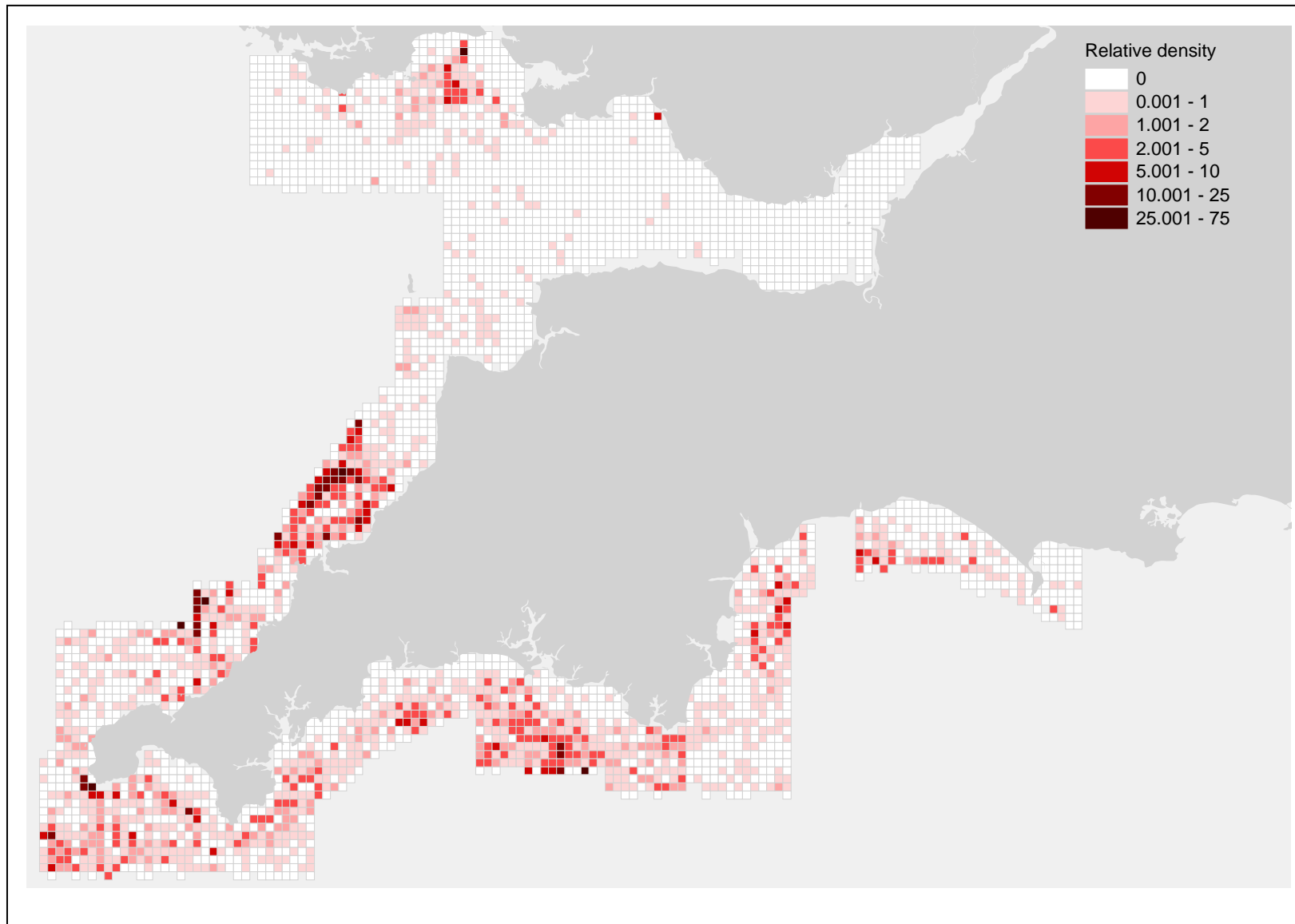
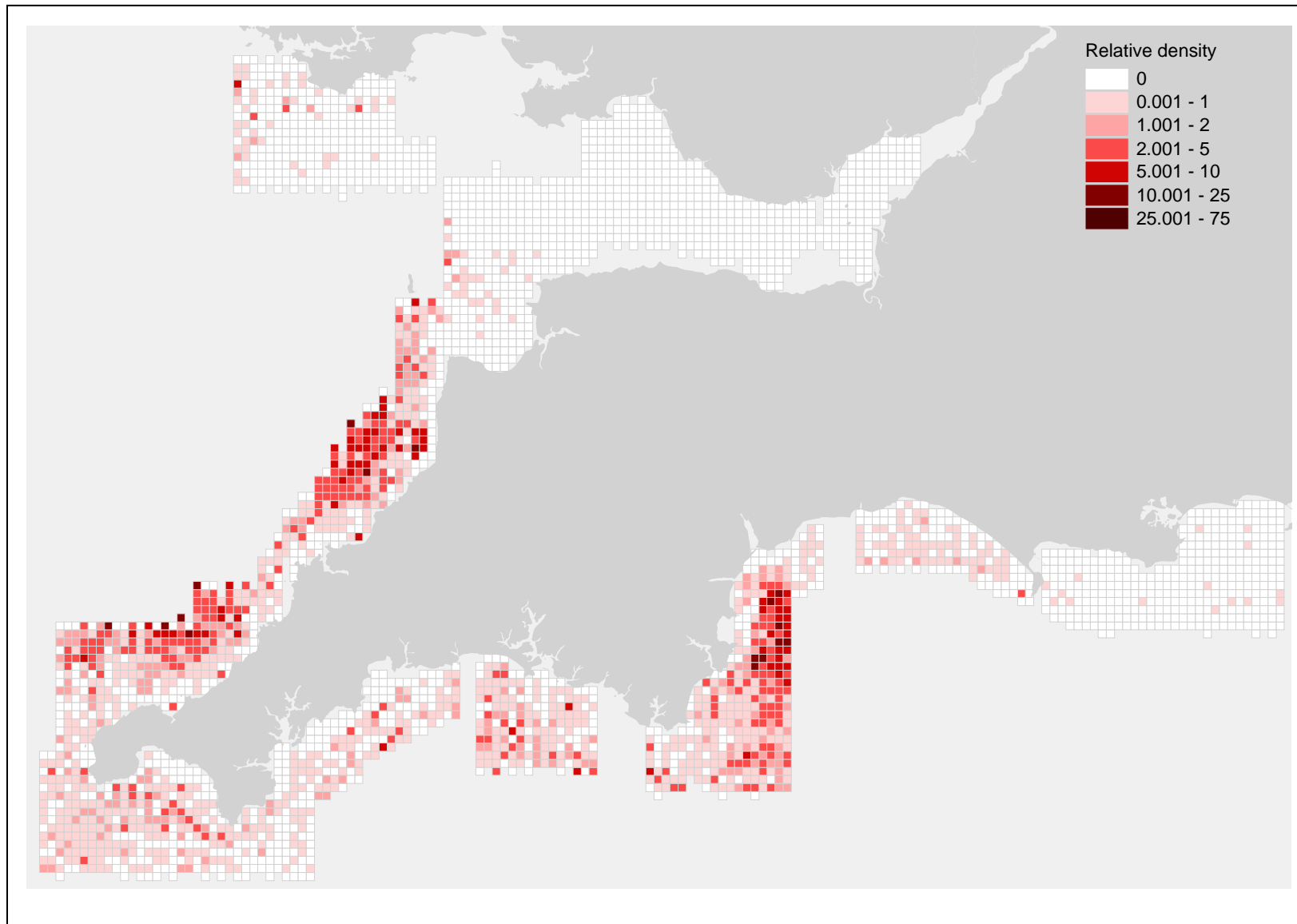


Figure 19 - Relative density of auks *Uria/Alca/Fratercula* spp. recorded in the South West Strategic Area during aerial surveys, Period 4.



TABLES

Tables presenting total numbers (Tables 3, 4, 5, 6, 8 & 10) are not absolute numbers of birds in the survey area, which need to be calculated using 'distance', to allow for the numbers of birds missed with increasing distance from the plane.

Estimated numbers of Common Scoter, divers, and auks presented in tables 7, 9 and 11 respectively, were calculated using *Distance 5.0*. Estimates were calculated for divers and auks in the whole South West Strategic Area in each Period. Only one estimate of Common Scoter could be calculated, SW3 in Period 3, as this survey block was not repeated in Period 4.

Table 1 - Survey Periods used for 2007 and previous strategic area aerial surveys.

Survey Period	Description	2004/05	2005/06	2007
1	Early winter	23 Oct - 21 Nov	17 Oct - 20 Nov	-
2	Mid winter (1)	22 Nov - 31 Dec	21 Nov - 31 Dec	-
3	Mid winter (2)	1 Jan - 9 Feb	1 Jan - 12 Feb	14 Jan - 4 Feb
4	Late winter	10 Feb - 11 Mar	13 Feb - 12 Mar	18 Feb - 17 Mar
5	Breeding: incubation	9 May - 5 Jun	8 May - 4 Jun	-
6	Breeding: chick rearing	6 Jun - 10 Jul	5 Jun - 9 Jul	-
7	Post fledging/moult	11 Jul - 21 Aug	10 Jul - 20 Aug	-

Table 2 - Dates of survey flights in the South West Strategic Area, Periods 3 & 4.

South West	SW2	SW3	SW4	SW5	SW6	SW10	SW11	SW12	SW13	SW14	SW15	SW16	SW17
Period 3	14 Jan	4 Feb	15 Jan	25 Jan	15 Jan	3 Feb	26 Jan	26 Jan	27 Jan	27 Jan	31 Jan	4 Feb	-
Period 4	18 Feb	-	19 Feb	21 Feb	20 Feb	13 Mar	14 Mar	14 Mar	16 Mar	16 Mar	13 Mar	17 Mar	17 Mar

Table 3 - Total numbers of all species in the South West Strategic Area, Periods 3 & 4.

Species	Period 3	Period 4
Red-throated Diver	34 (1)	5
Black-throated Diver	3 (3)	10
Great Northern Diver	4 (2)	
diver sp.	65 (37)	42
grebe sp.	2 (1)	
Fulmar	267 (266)	275
Manx Shearwater		221
Gannet	1362 (1362)	1072
Cormorant	25 (14)	46
Shag	138 (135)	85
Cormorant/Shag	132 (132)	41
yellow-billed swan sp.	2 (2)	
Wigeon	5 (5)	4
Teal		7
Mallard	5 (5)	
Eider		4
Common Scoter	13114 (7)	12
Red-breasted Merganser	8 (0)	
duck sp.	13 (11)	14
Oystercatcher	845 (0)	
Dunlin	20 (0)	
Curlew	8 (0)	
small wader sp.	6 (0)	
Great Skua	4 (4)	
Little Gull	1 (1)	
Black-headed Gull	384 (249)	43
Common Gull	43 (18)	38
Lesser black-backed Gull	30 (23)	76
Herring Gull	2822 (2313)	954
Great Black-backed Gull	88 (87)	49
Kittiwake	1379 (1373)	616
grey gull spp (Herring or Common)	480 (463)	1416
black-backed gull spp	124 (120)	123
large gull sp.	1145 (993)	285
small gull sp.	240 (237)	479
gull sp.	4857 (4336)	6736
Guillemot	15 (15)	38
Razorbill	15 (15)	1
auk sp.	8616 (8014)	8314
Carrion Crow	45 (0)	

Table 4 - Numbers of birds recorded in each South West Strategic Area survey block, Period 3.

Species	SW2	SW3	SW4	SW5	SW6	SW10	SW11	SW12	SW13	SW14	SW15	SW16	Total
Red-throated Diver		33									1		34
Black-throated Diver								1	2				3
Great Northern Diver		2				1			1				4
diver sp.	1	28	1		5	6	1	2	7	9	2	3	65
grebe sp.		1									1		2
Fulmar	65	1	11		5	5	74	71	14	5	10	6	267
Gannet						121	568	307	137	162	31	36	1362
Cormorant		11					2		5	1	6		25
Shag		3				2	3	9	104	7	10		138
Cormorant/Shag							3		127		2		132
yellow-billed swan sp.			2										2
Wigeon						5							5
Mallard				5									5
Common Scoter		13107	7										13114
Red-breasted Merganser		8											8
duck sp.		2		11									13
Oystercatcher		845											845
Dunlin		20											20
Curlew		8											8
small wader sp.		6											6
Great Skua								3		1			4
Little Gull											1		1
Black-headed Gull	19	135	32	1			1		196				384
Common Gull		25	4	3						2	7	2	43
Lesser black-backed Gull		7	4				2	10	4	2	1		30
Herring Gull	1	509	2	23	1	581	27	457	1026	68	84	43	2822
Great Black-backed Gull	1	1	1		1	5	8	19	26	13	11	2	88
Kittiwake	16	6	6		30	231	362	227	122	185	154	40	1379
grey gull spp (Herring or Common)	3	17	2	11	18	1	10	3	5	19	216	175	480
black-backed gull spp		4		2		7	2	6	18	35	45	5	124
large gull sp.	3	152	1	19	4	154	30	602	12	72	17	79	1145
small gull sp.	164	3	1	1	15	4	20	1		28		3	240

Species	SW2	SW3	SW4	SW5	SW6	SW10	SW11	SW12	SW13	SW14	SW15	SW16	Total
gull sp.	3	521	123	209	24	716	111	1873	716	379	50	132	4857
Guillemot								7	8				15
Razorbill						4		1	10				15
auk sp.	61	602	8		62	2318	1204	1380	751	1295	567	368	8616
Carrion Crow		45											45
Total	337	16102	205	285	165	4161	2428	4979	3291	2283	1216	894	36346

Table 5 - Numbers of birds recorded in each South West Strategic Area survey block, Period 4.

Species	SW2	SW4	SW5	SW6	SW10	SW11	SW12	SW13	SW14	SW15	SW16	SW17	Total
Red-throated Diver				1		1	2	1					5
Black-throated Diver						2		2		3	3		10
diver sp.		1		1	5	6	3	8	1	10	7		42
Fulmar	15	6	1	58	26	45	74	36	3	3	6	2	275
Manx Shearwater					155	36	5	21	4				221
Gannet	234	2		11	74	90	142	187	46	280	4	2	1072
Cormorant						5	5	17	1	11	6	1	46
Shag					4	24	27	24	1	1	2	2	85
Cormorant/Shag	1					27		1		6		6	41
Wigeon												4	4
Teal			7										7
Eider			4										4
Common Scoter			1		10	1							12
duck sp.			14										14
Black-headed Gull		3	34	1				1		4			43
Common Gull	4	6	2	13				2		3	5	3	38
Lesser black-backed Gull	3	2	14	1	22	2	15	10	1	4	2		76
Herring Gull	8	3	132	13	43	18	64	62	393	186	17	15	954
Great Black-backed Gull	1		4	2	4	1	8	3	19	4	3		49
Kittiwake	53	2		11	164	67	79	62	101	66	8	3	616
grey gull spp (Herring or Common)	194	43	18	48	255	11	715	36	3	32	57	4	1416
black-backed gull spp			19	2	13	12	21	8	4	36	6	2	123
large gull sp.	2		18	3	17	24	2	49	12	118	6	34	285
small gull sp.	5	1	55	12	4	30	40	13	18	284	15	2	479
gull sp.	19	4	39	18	188	61	326	1050	311	4579	140	1	6736
Guillemot						1	8	2		24	3		38
Razorbill							1						1
auk sp.	164			69	2123	1672	736	360	672	2328	179	11	8314
Total	703	73	362	264	3107	2136	2273	1955	1590	7982	469	92	21006

Table 6 - Numbers of Common Scoters *Melanitta nigra* recorded ("-" indicates no coverage).

Survey Block	Period 3	Period 4
SW2		
SW3	13107	-
SW4	7	
SW5		1
SW6		
SW10		10
SW11		1
SW12		
SW13		
SW14		
SW15		
SW16		
SW17	-	
South West Total	13114	12

Table 7 - Estimates of Common Scoter *Melanitta nigra* numbers (with 95% bootstrap confidence intervals) calculated using Distance 5.0.

Survey Block	Estimate	Lower Confidence Interval	Upper Confidence Interval
Period 3 South West (SW3 only)	26127	13933	44122

Table 8 - Numbers of divers *Gavia* spp. recorded ("-" indicates no coverage).

Survey Block	Period 3	Period 4
SW2	1	
SW3	63	-
SW4	1	1
SW5		
SW6	5	2
SW10	7	5
SW11	1	9
SW12	3	5
SW13	10	11
SW14	9	1
SW15	3	13
SW16	3	10
SW17	-	
South West Total	106	57

Table 9 - Estimates of diver *Gavia* spp. numbers (with 95% bootstrap confidence intervals) calculated using Distance 5.0.

Survey Block	Estimate	Lower Confidence Interval	Upper Confidence Interval
Period 3 South West	583	331	884
Period 3 SW3 Red-throated Divers only	185	67	326
Period 4 South West	369	238	594

Table 10 - Numbers of auks *Uria/Alca/Fratercula* spp. recorded ("-" indicates no coverage).

Survey Block	Period 3	Period 4
SW2	61	164
SW3	602	-
SW4	8	0
SW5	0	0
SW6	62	69
SW10	2322	2123
SW11	1204	1673
SW12	1388	745
SW13	769	362
SW14	1295	672
SW15	567	2352
SW16	368	182
SW17	-	11
South West Total	8646	8353

Table 11 - Estimates of auk *Uria/Alca/Fratercula* spp. numbers (with 95% bootstrap confidence intervals) calculated using Distance 5.0.

Survey Block	Estimate	Lower Confidence Interval	Upper Confidence Interval
Period 3 South West	51806	44521	58927
Period 4 South West	39864	34574	45702